GE HealthCare

SIGNA™ Victor / SIGNA™ Star AIR / SIGNA™ Aviator AIR

Preinstallation Manual

5917976-8EN
Revision 4

Contents

Language Policy

DOC0371395 - Global Language Procedure

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1 Introduction

1.1 Preinstall Manual Introduction

(Applies to all subsections within this section)

1.1.1 Document Purpose

This preinstallation manual provides the necessary information to prepare a site for system installation. Specifically, this manual provides information:

1. To define system requirements and interactions.
2. For the effective arrangement and interconnection of system components.
3. The customer is responsible for:
   - 3.1. Compliance with all local and national codes and regulations
   - 3.2. Siting requirements for customer-specific site procedures (medical, MR, safety, and so on)
   - 3.3. Any special architectural requirements (for example, seismic codes)

The implementation of all requirements and adherence to all specifications in this manual is the responsibility of the customer or its architect and engineers. Refer any questions to the GE HealthCare Project Manager of Installation (PMI).

1.1.2 Intended User

The primary users of this manual are the customer, the customer's architectural planner, and/or the customer's contractors.

1.1.3 Who Should Read This Manual

The following personnel must be aware of the content listed in the following sections:

Table 1-1 Personnel Index

Section	Personnel						
							
	Architect	General Contractor	Customer	Electrician	Plumber	HVAC	RF Vendor
1.1 Preinstall Manual Introduction	x	x	x	x	x	x	x
2.1 System Level Requirements for Installing into Existing MR Suite	x	x					
2.2 System components	x	x					
2.3 MR Suite Minimum Room Size Requirements	x						
2.4 MR System Seismic Requirements	x	x					
2.5 Structure-borne Vibration Control Specifications	x						
2.6 MR Suite Magnetic Field Specifications	x		x				
2.7 Multiple MR System Requirements	x						
2.8 MR Suite Temperature and Humidity	x	x			x	x	
2.9 Facility Coolant Requirements	x	x			x	x	
2.10 MR Suite Electrical Requirements	x			x			
2.11 MR System Shipping and Receiving	x						
3.1 Magnet Room Introduction	x	x					
3.2 Magnet Room Structural Requirements	x						
3.2.1 Overview	x						
3.2.2 Environmental Steel Limits	x						
3.2.3 Vibration Requirements	x	x				x	
3.3 Magnetic Shielded Room Requirements	x						
3.4 Integrated System Cabinet (ISC) and Penetration Panel (PP) Wall Opening Requirements	x		x				x

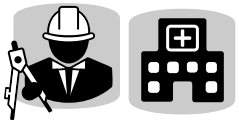
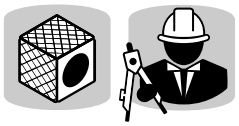
Table 1-1 Personnel Index (Table continued)

Section	Personnel						
	 Architect	 General Contractor	 Customer	 Electrician	 Plumber	 HVAC	 RF Vendor
3.5.1 Ferrous Materials in the Magnet Room	x	x	x				
3.5.2 Walls	x						
3.5.3 Magnet Preinstallation Markings	x						
3.5.4 Doors, Magnet Access Openings, and Patient Viewing Windows	x						
3.5.5 Finished Ceiling	x						
3.5.6 Magnet Room Floors	x	x					
3.5.7 Storage Cabinets	x	x					
3.6 Magnet Room Equipment Specifications	x	x					
3.7 Magnet Room Lighting Requirements	x			x			
4 Equipment Room chapter	x	x					
5 Control Room chapter	x	x					
6 Digital Service and Connectivity chapter	x			x			
7.1 MR System Interconnects Specifications	x	x		x			
7.2 MR System Interconnects Routing Requirements	x	x		x			
7.3 Facility-Supplied System Interconnects Specifications	x	x		x	x	x	
8.1 Glossary	x	x	x	x	x	x	x
8.2 MR Site Vibration Test Guidelines	x						
8.3 Sample Calculation AC Power Equipment Minimum Distance	x						
8.4 Selecting Anchor Size	x	x					
8.5 Sample control schematic for customer-supplied MDP	x			x			

1.1.4 Related Publications

The preinstallation requirements in the following publications are applicable to all systems. This document and all documents referenced herein shall be provided to the Responsible Organization or Operator as a supplement to the product instructions for use and/or technical description.

Table 1-2 Additional Preinstallation Requirements

Publication Number	Title	Personnel who must be aware of the content
5850262-1EN	*Acoustic Room Details*	
5850261-1EN	*International Electrotechnical Commission (IEC) Electro-magnetic Compatibility (EMC)*	
5850263-1EN	*Magnet Room Venting*	
5850260-1EN	*RF Shielded Room*	

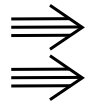
1.1.5 Document Overview

This manual describes requirements and specifications for the following:

1. General system requirements that apply to the entire MR suite
2. Shipping and delivery
3. Magnet Room
4. Equipment Room
5. Control Room
6. Interconnects within and between the rooms listed above

1.2 Symbols Key

Table 1-3 Symbols Key

Symbol/Unit	Definition
	Center of gravity
	Magnet isocenter
	Service area
	Airflow
	Space for airflow and cables
	Valve

2 General System Level

2.1 System Level Requirements for Installing into Existing MR Suite

When planning for the installation of this system in an existing GE HealthCare MR suite or a non-GE HealthCare MR suite, all requirements in this manual must be met because these rooms are considered new installations.

1. If the existing MR suite contains a GE HealthCare system, the vibration environmental assessment must be done using the High Speed (magnetic field) Stability tool.

   NOTE
   The customer may have to hire a vibration consultant based on the results of the analysis.

2. Structural vibration levels may be higher at some frequencies than other MR Systems, which may increase acoustic levels. Refer to 2.5 Structure-borne Vibration Control Specifications on page 23.
3. The VibroAcoustic damping kit must be surface mounted (if the floor is recessed, it must be filled in and level).
4. RF vendor responsibilities:
   4.1. The old dock anchor cannot be reused. It must be removed and the hole filled in. The new anchor is reset after the magnet is installed. For upgrades that reuse the existing magnet, contact the PMI for further details about the potential reuse of the old dock anchor.
   4.2. Two penetration panel openings are required and must meet the requirements in: *RF Shielded Room Requirements*, 5850260-1EN.
   4.3. RF shield attenuation must comply with: *RF Shielded Room Requirements*, 5850260-1EN
5. Cryogen vent may need to be relocated to align with the Magnet Cryogen Vent opening. The cryogen vent must meet all cryogen venting requirements (see *Magnet Room Venting Requirements*, 5850263-1EN).

2.2 System components

(Applies to all subsections within this section)

This system consists of the following components:

2.2.1 Magnet Room

1. 1.5T Magnet and Magnet Enclosure (MAG) and Vibroacoustic Damping Kit
2. Rear Pedestal (PED)
3. Patient Table (PT)
4. Magnet Rundown Unit (MRU)

   NOTE
   An optional remote MRU may be located outside the Magnet Room.

5. Optional: Remote Oxygen Sensor Module (OM2)

2.2.2 Equipment Room

1. Main Disconnect Panel (MDP) (may be customer-supplied in exempt regions)
2. Integrated System Cabinet (ISC)
3. Integrated Cooling Cabinet (ICC) (For Type B)
4. Penetration Panel (PP)
5. Cryocooler Compressor Cabinet (CRY)
6. 18 kW Chiller (LCS18) (For Type D)
7. Magnet Monitor (MON)
8. Optional: Magnetic Resonance Elastography (MRE)

2.2.3 Control Room

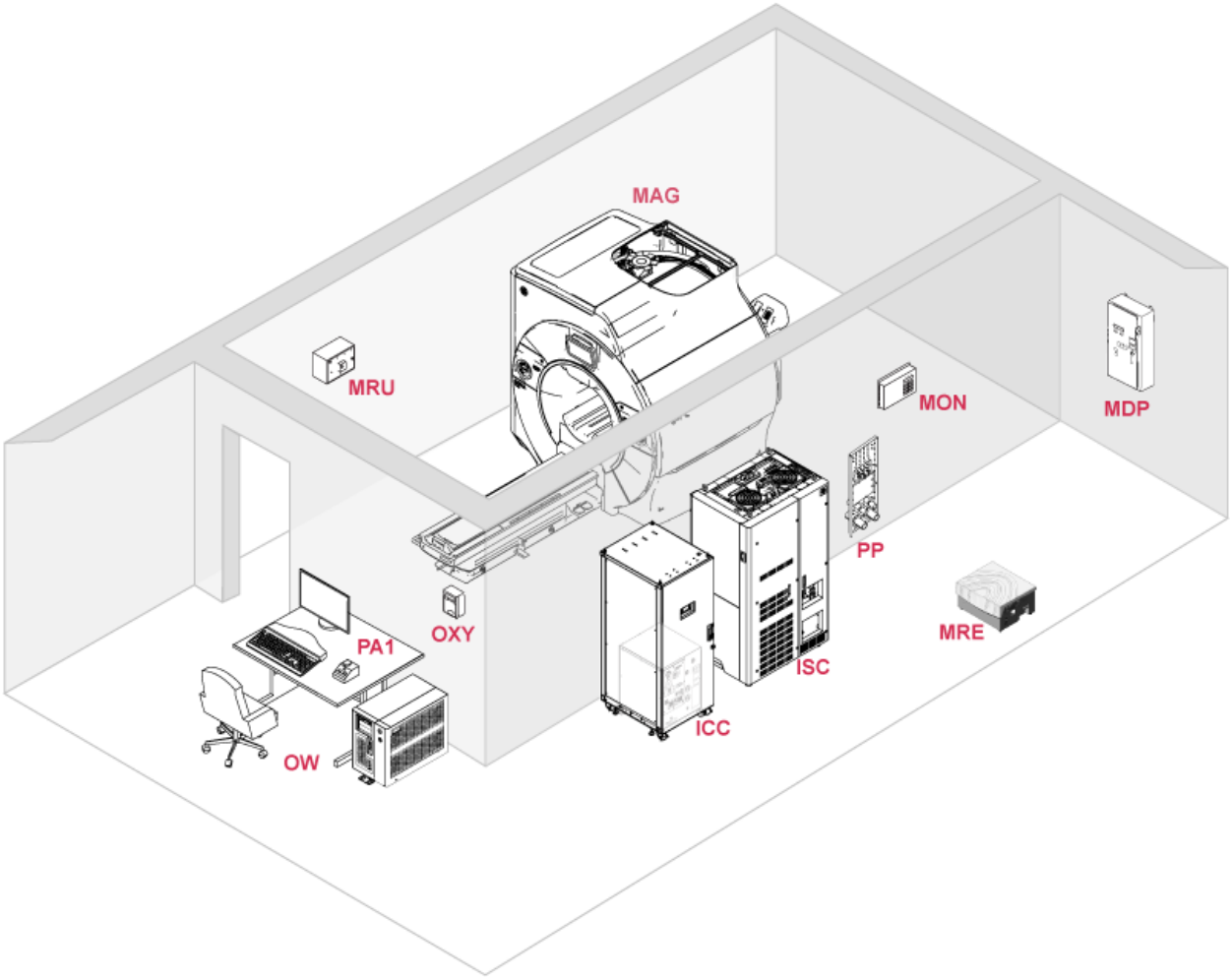
1. Operator Workspace equipment (OW)
2. Pneumatic Patient Alert System (PA1)
3. Optional: Oxygen Monitor (OXY)

2.2.4 Accessories

1. Patient accessories, including RF coils, phantoms, cushions, sponges, straps, and wedges
2. Gating accessories, including patient cardiac leads, peripheral gating probe, and respiratory bellows

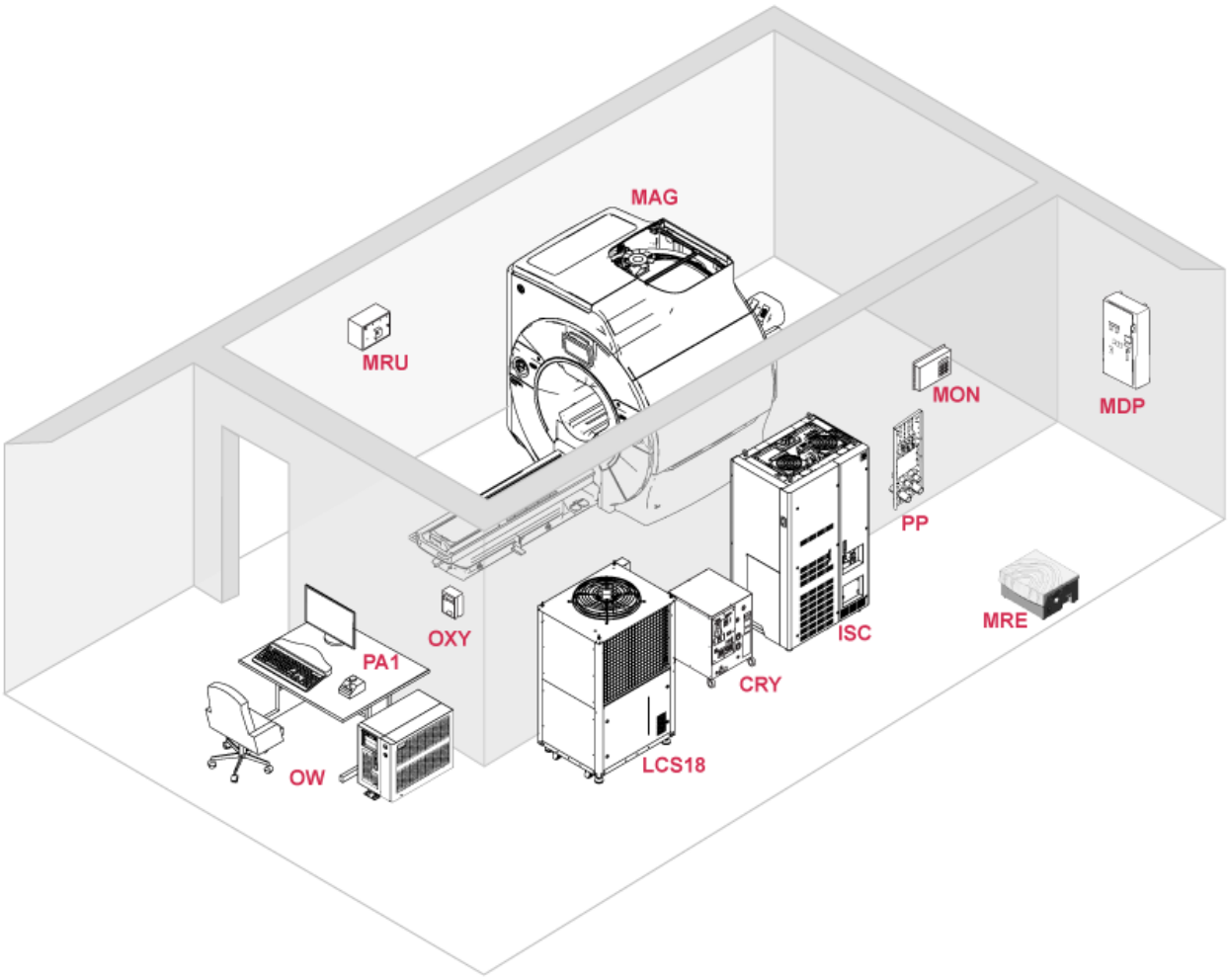
2.2.5 System Overview

Figure 2-1 System Overview for Type B



NOTE
MRE and OXY shown above are optional components of the system.

Figure 2-2 System Overview for Type D



NOTE
MRE and OXY shown above are optional components of the system.

2.3 MR Suite Minimum Room Size Requirements

Room dimensions shown in the table below are the minimum finished room space requirements to safely install and service the MR System. Minimum dimensions are for service only. Room size may increase due to the items listed below, which are not included in the minimum area dimensions:

1. Building code requirements (for example, exit routes, door placement, seismic mounting requirements, local and national electrical codes, and so on).
2. Equipment and Magnet Room evacuation routes to comply with facility emergency procedures.
3. System requirements, including cable run locations, cryogen venting, patient observation requirements, and penetration panel placements.
4. Penetration panel closet and all associated areas.
5. GE HealthCare optional equipment, such as MRE, accessories, and so on.
6. Non-GE HealthCare equipment options (such as additional AC or water cooling equipment in the Equipment Room).
7. Clinical workflow considerations.
8. Accessory storage. Refer to *Customer Site Storage Requirements*, 5182674 (available in the Customer Documentation Portal), or contact the GE HealthCare Project Manager of Installation (PMI) for any additional accessory storage requirements.
9. Magnetic field containment, for example, the 5 gauss line to the room. If fringe field containment is needed, see 2.6 MR Suite Magnetic Field Specifications on page 26.
10. The minimum service area shown must be kept clear of permanent or installed cabinetry, the MRU, the penetration closet, millwork, shelving, coil storage fixtures, furniture, and so on.

Table 2-1 Room Dimensions to Satisfy Recommended Minimum Service Area Requirements

Configuration	Equipment Room [1]			Magnet Room [2]			Control Room		Total System Area
	W x D mm (in)	Area m^2 (ft^2)	Finished Ceiling Height mm (in)	W x D mm (in)	Area m^2 (ft^2)	Finished Ceiling Height mm (in)	W x D mm (in)	Area m^2 (ft^2)	Area m^2 (ft^2)
Type B (ICC configuration)	1826 x 2626 (71.9 x 103.4)	4.8 (51.6)	2355 (92.7)	**Long scan range:** 3645 x 5802 (143.5 x 228.4)	**Long scan range:** 18.8 (202.2)	2500 (98.4)	1520 x 2130 (59.8 x 83.9)	3.2 (34.9)	**Long scan range:** 26.8 (288.7)

Table 2-1 Room Dimensions to Satisfy Recommended Minimum Service Area Requirements (Table continued)

Configuration	Equipment Room [1]			Magnet Room [2]			Control Room		Total System Area
	W x D mm (in)	Area m^2 (ft^2)	Finished Ceiling Height mm (in)	W x D mm (in)	Area m^2 (ft^2)	Finished Ceiling Height mm (in)	W x D mm (in)	Area m^2 (ft^2)	Area m^2 (ft^2)
Type D (18KW chiller configuration)	1804 x 2693 (71 x 106)	4.9 (52.3)		**Long scan range:** 3645 x 5802 (143.5 x 228.4)	**Long scan range:** 18.8 (202.2)		1520 x 2130 (59.8 x 83.9)	3.2 (34.9)	**Long scan range:** 26.9 (289.4)

[1] See Figure 4-1 Typical Minimum Equipment Room with Service Clearances (Type B) on page 90 or Figure 4-2 Typical Minimum Equipment Room with Service Clearances (Type D) on page 91 for specific dimensions.

[2] See Figure 2-3 Recommended Minimum Magnet Service Area (Top View) on page 19 for specific dimensions.

Table 2-2 Room Dimensions to Satisfy Absolute Minimum Service Area Requirements

Configuration	Equipment Room [1]			Magnet Room [2]			Control Room		Total System Area
	W x D mm (in)	Area m^2 (ft^2)	Finished Ceiling Height mm (in)	W x D mm (in)	Area m^2 (ft^2)	Finished Ceiling Height mm (in)	W x D mm (in)	Area m^2 (ft^2)	Area m^2 (ft^2)
Type B (ICC configuration)	1826 x 2626 (71.9 x 103.4)	4.8 (51.6)	2355 (92.7)	**Long scan range:** 3368 x 5518 (132.6 x 217.2) **Short scan range:** 3368 x 5425 (132.6 x 213.6)	**Long scan range:** 15.5 (166.7) **Short scan range:** 15.2 (164.0)	2500 (98.4)	1520 x 2130 (59.8 x 83.9)	3.2 (34.9)	**Long scan range:** 23.5 (253.2)
									Short scan range: 23.2 (250.5)
Type D (18KW chiller configuration)	1804 x 2693 (71 x 106)	4.9 (52.3)							**Long scan range:** 23.6 (253.9)
									Short scan range: 23.3 (251.2)

Table 2-2 Room Dimensions to Satisfy Absolute Minimum Service Area Requirements (Table continued)

Configuration	Equipment Room [1]			Magnet Room [2]			Control Room		Total System Area
	W x D mm (in)	Area m^2 (ft^2)	Finished Ceiling Height mm (in)	W x D mm (in)	Area m^2 (ft^2)	Finished Ceiling Height mm (in)	W x D mm (in)	Area m^2 (ft^2)	Area m^2 (ft^2)

[1] See Figure 4-1 Typical Minimum Equipment Room with Service Clearances (Type B) on page 90 or Figure 4-2 Typical Minimum Equipment Room with Service Clearances (Type D) on page 91 for specific dimensions.

[2] See Figure 2-4 Absolute Minimum Magnet Service Area (Top View) on page 20 and Figure 2-5 Smallest Permissible Area for Minimum Magnet Ceiling Height (Top View) on page 21 for specific dimensions.

Figure 2-3 Recommended Minimum Magnet Service Area (Top View)

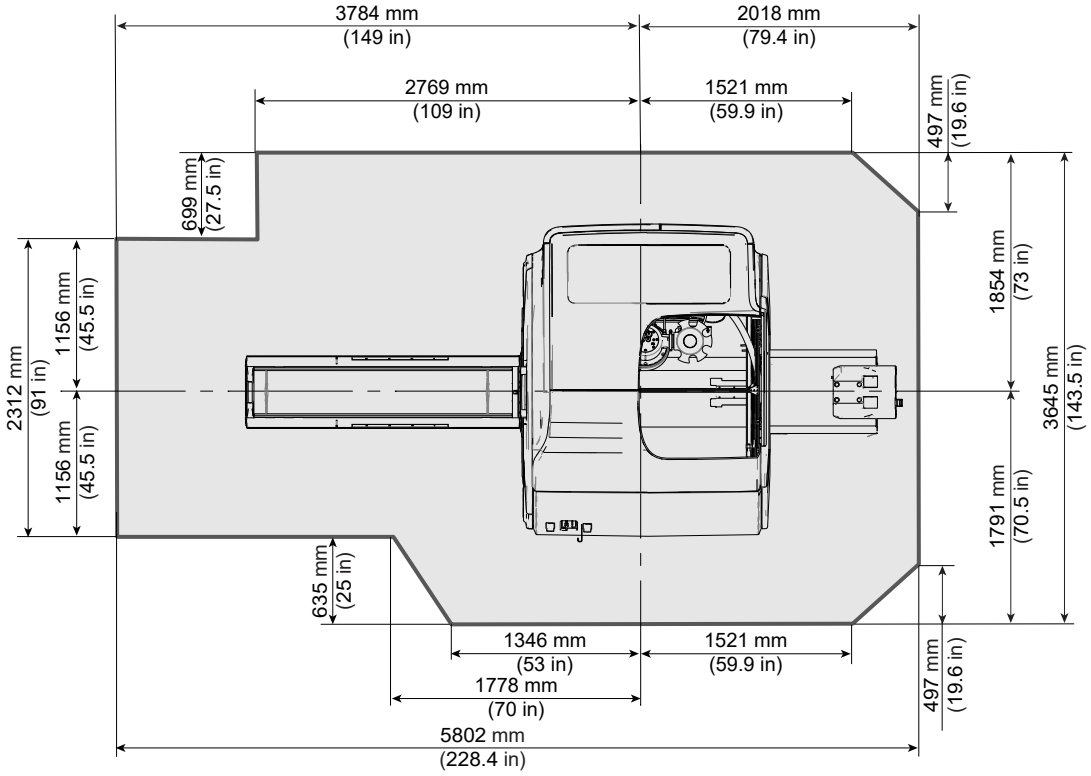
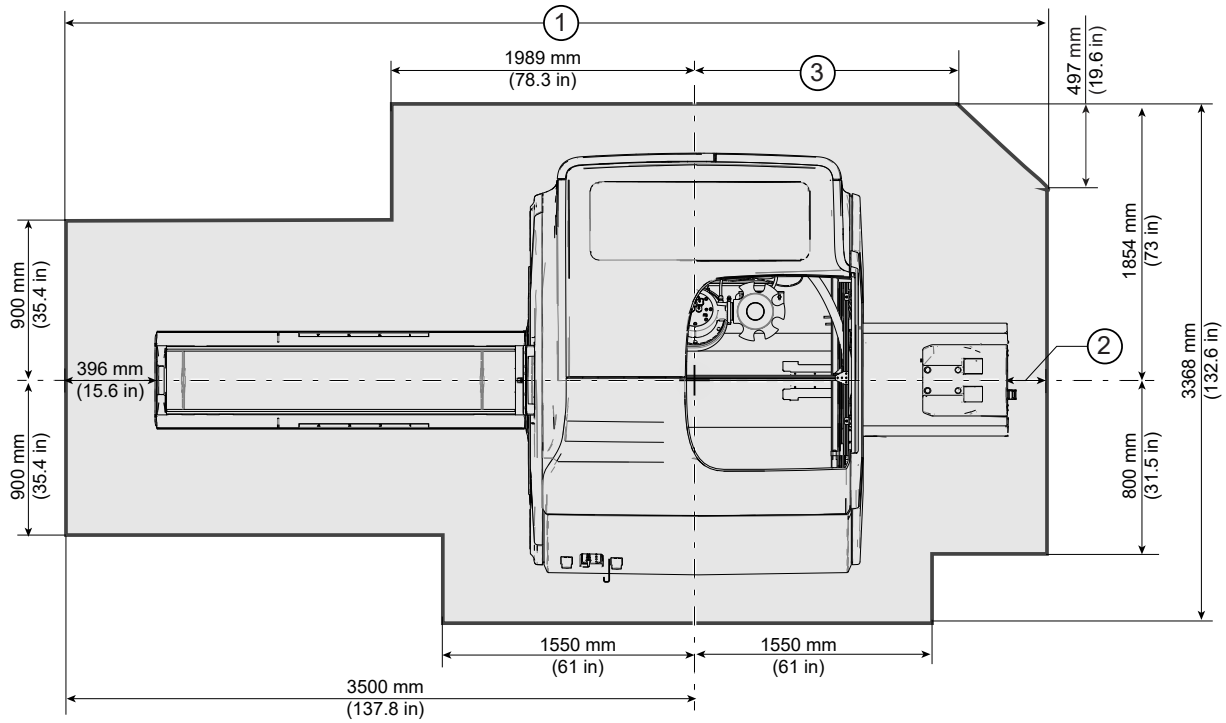


Figure 2-4 Absolute Minimum Magnet Service Area (Top View)

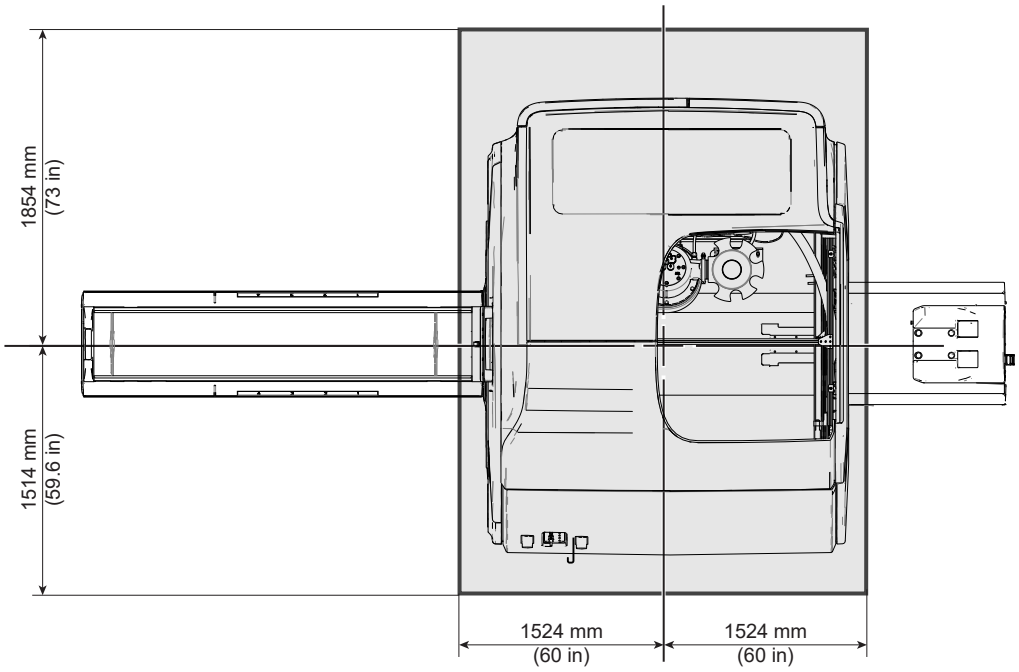


Item	Description
1	5425 mm (213.6 in.) - Short scan range 5518 mm (217.2 in.) - Long scan range
2	100 mm (3.9 in.) - Short scan range 193 mm (7.6 in.) - Long scan range
3	1428 mm (56.2 in.) - Short scan range 1521 mm (59.9 in.) - Long scan range

The following requirements apply to the Magnet Room finished ceiling:

1. Ideal Magnet Room suspended ceiling height is 2667 mm (105 in.). Minimum Magnet Room suspended ceiling height is 2500 mm (98.5 in). See Figure 2-5 Smallest Permissible Area for Minimum Magnet Ceiling Height (Top View) on page 21.
2. The ceiling service area should be kept clear of overhead items, including soffits, HVAC, plumbing components, and brackets. Permanent or installed objects in this area may prevent or delay magnet service or operation.

Figure 2-5 Smallest Permissible Area for Minimum Magnet Ceiling Height (Top View)



NOTE

If the ceiling height is between **2500 mm (98.5 in) and 2667 mm (105 in)**, the flexible main lead extension for low ceiling height (2.5M Low Ceiling Kit-Passive, M7000GM) is required for ramping the magnet. Contact the GE PMI and GE Service Field Engineer for further evaluation.

The following requirements apply to the Equipment Room ceiling:

1. Minimum Equipment Room height from finished floor to ceiling is 2355 mm (92.7 in.). For Type D configuration, if the ceiling height is between 2355mm (92.7 in.) and 2500mm (98.4 in.), a duct should be provided by local vendor. See Figure 4-12 Duct (Option 1) on page 102 and Figure 4-13 Duct (Option 2) on page 103.
2. The ceiling service area should be kept clear of overhead items, including soffits, HVAC, plumbing components, and brackets. Permanent or installed objects in this area may prevent or delay magnet service or operation.

2.4 MR System Seismic Requirements

Contact the Project Manager of Installation with any questions.

1. The customer is responsible for seismic anchoring of GE HealthCare components.
2. Center of gravity, weight, physical dimensions, and attachment points are provided for seismic calculations. Refer to the specifications or illustrations for each component (see Magnet

Room Equipment Specifications on page 84, Equipment Room on page 89, and Control Room on page 107).

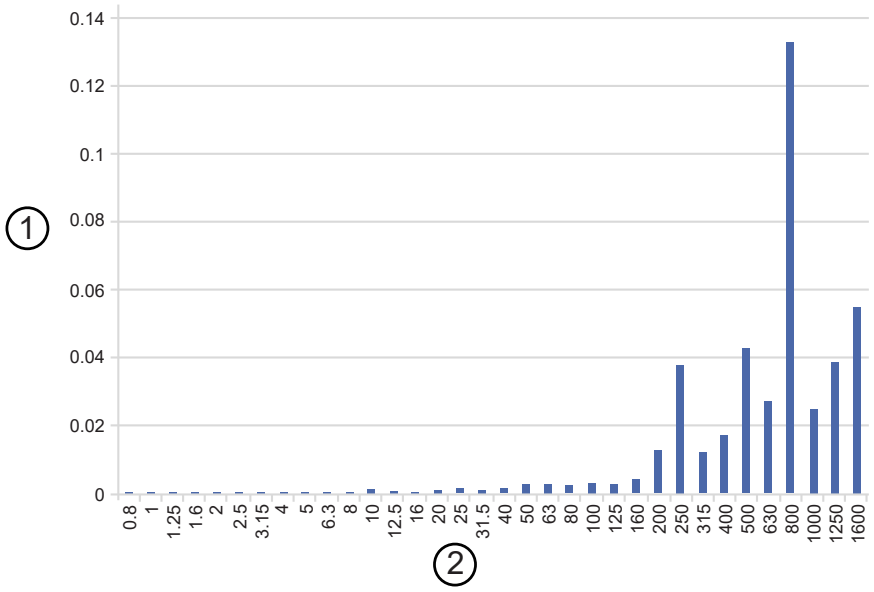
2.5 Structure-borne Vibration Control Specifications

Structure-borne acoustic issues tend to occur at MR installations above the ground floor of the facility. Two options to mitigate structure-borne acoustic transmission are:

1. GE HealthCare provides a VibroAcoustic Damping kit (which must be surface mounted). Contact the GE HealthCare Project Manager of Installation for information.
2. The customer may design and implement a custom solution in addition to the VibroAcoustic Damping kit. See Figure 2-6 Vibration Transmitted through VibroAcoustic Mat for R magnet on page 23 and Figure 2-7 Vibration Transmitted through VibroAcoustic Mat for PM magnet on page 24 for the plot of spectral vibration transmitted through the VibroAcoustic mat into the floor. If required, the customer should consult an acoustic engineer for a solution to further attenuate this transmitted vibration).

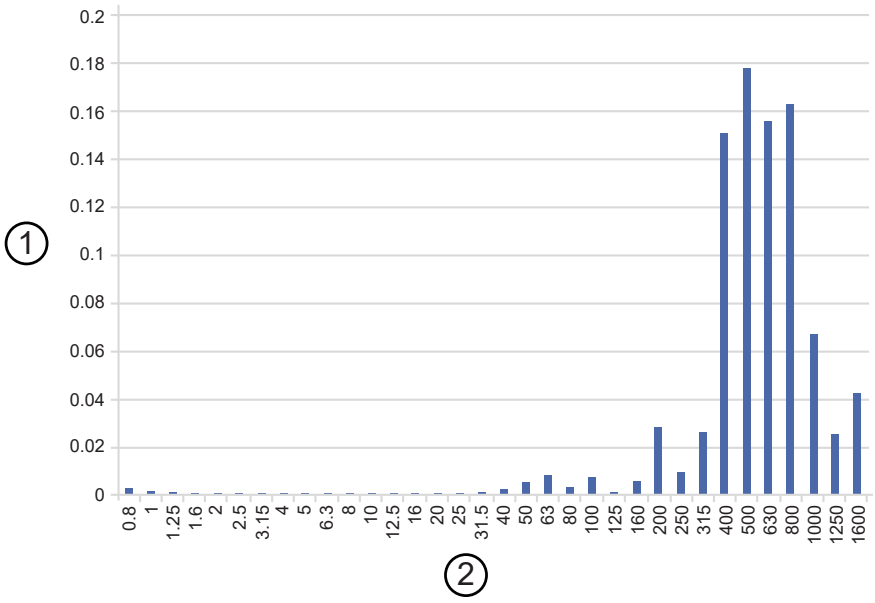
NOTE
The amount of vibration attenuation provided by the VibroAcoustic Damping kit will be site dependent.

Figure 2-6 Vibration Transmitted through VibroAcoustic Mat for R magnet



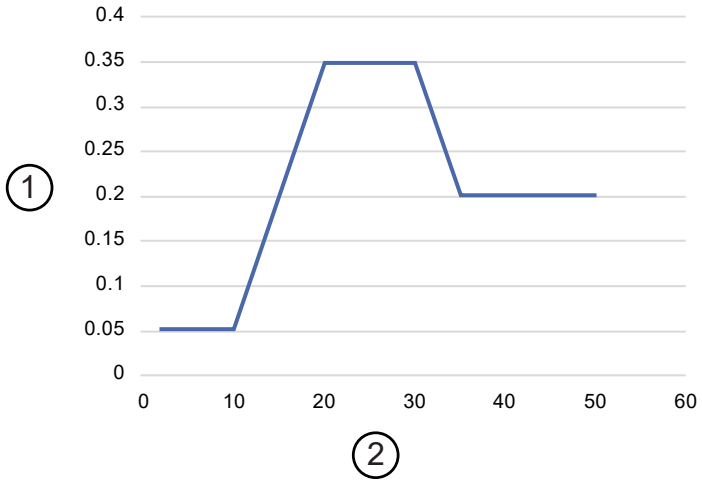
Item	Description
1	Acceleration [m/s^2]
2	1/3 Octave Frequency [Hz]

Figure 2-7 Vibration Transmitted through VibroAcoustic Mat for PM magnet



Item	Description
1	Acceleration [m/s^2]
2	1/3 Octave Frequency [Hz]

Figure 2-8 Low Frequency Magnet Floor Vibration (Vibration Amplitude at Each Foot) for PM and R magnet



Item	Description
1	Vibration Amplitude (m/s^2)
2	Frequency (Hz)

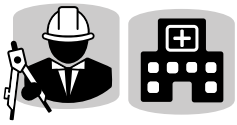
Frequency (Hz)	Amplitude (m/s^2)
2	0.05
10	0.05
20	0.35
30	0.35
35	0.20
50	0.20

Low Frequency Magnet Floor Vibration Notes:

NOTE

1. Illustrations above define the potential vibration level that may pass into the customer site. Figure 2-6 Vibration Transmitted through VibroAcoustic Mat for R magnet on page 23 and Figure 2-7 Vibration Transmitted through VibroAcoustic Mat for PM magnet on page 24 is the high frequency audible vibration. Figure 2-8 Low Frequency Magnet Floor Vibration (Vibration Amplitude at Each Foot) for PM and R magnet on page 25 is low frequency vibration that may dynamically displace the floor.
2. Vibration transfer may be the result of customer specific building construction as low levels of vibration transmit into the building through airborne and structure-borne paths. Customer MR clinicians recognize the vibration defined in the illustrations above is typically short bursts of vibration repeated multiple times as the scan progresses.
3. The customer should consider the impact of this vibration for the evaluation and design solution.

2.6 MR Suite Magnetic Field Specifications



(Applies to all subsections within this section)

2.6.1 Magnetic Fringe Field

The following illustrations show the static magnet isogauss plot lines for the magnet. This information must be used to evaluate potential site interaction of GE HealthCare equipment with other non-GE HealthCare equipment, interaction with ferrous materials on the site, and to locate personnel and equipment within the site.

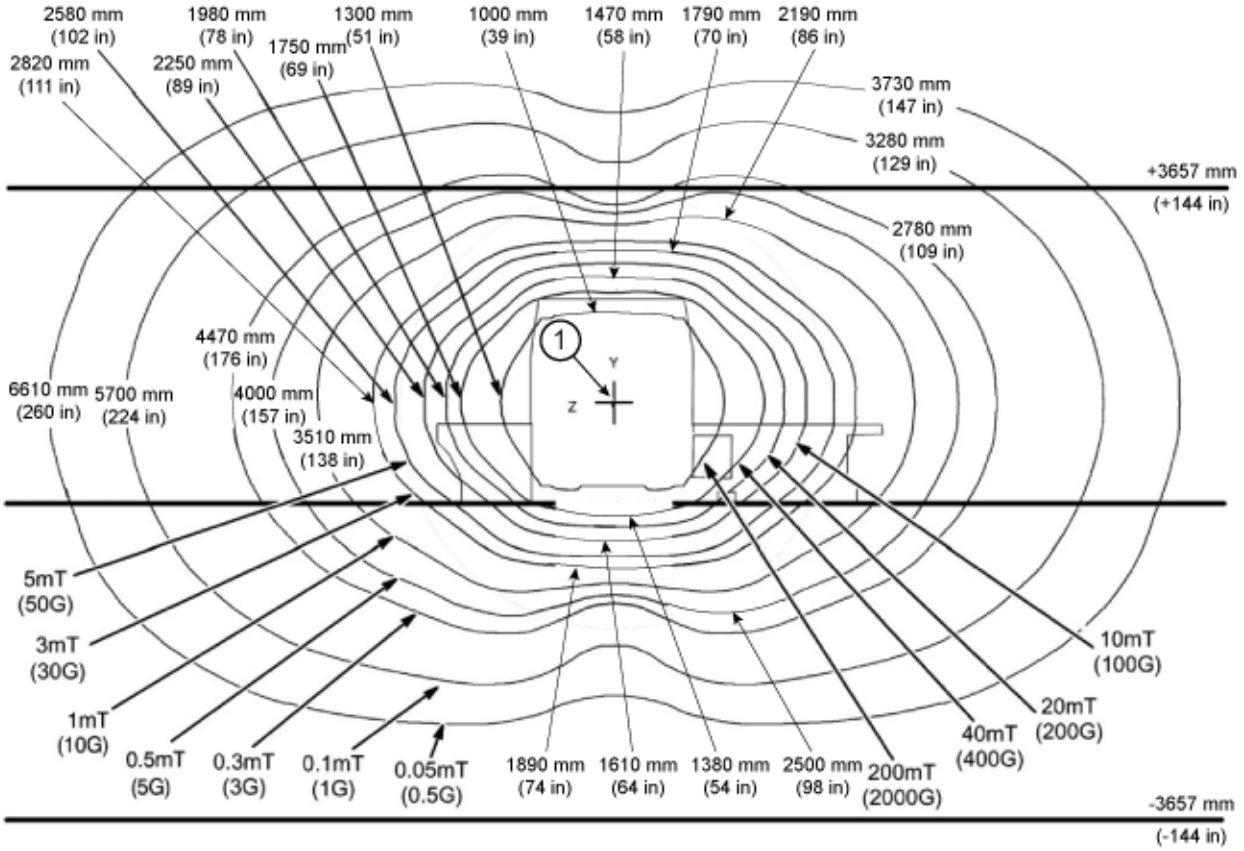
For LCC R magnet: The 0.5 mT (5G) line can expand to 7.5 m (24.61 ft.) axially and 6.0 m (19.68 ft.) radially for up to 2 seconds in the rare event of a quench.

For PM magnet: The 0.5 mT (5G) line can expand to 4.5 m (14.76 ft.) axially and 3.5 m (11.48 ft.) radially for up to 1 second in the rare event of a quench.

The isogauss plots show an idealized magnetic field relative to magnet isocenter. The actual field strength can be affected by any of the following:

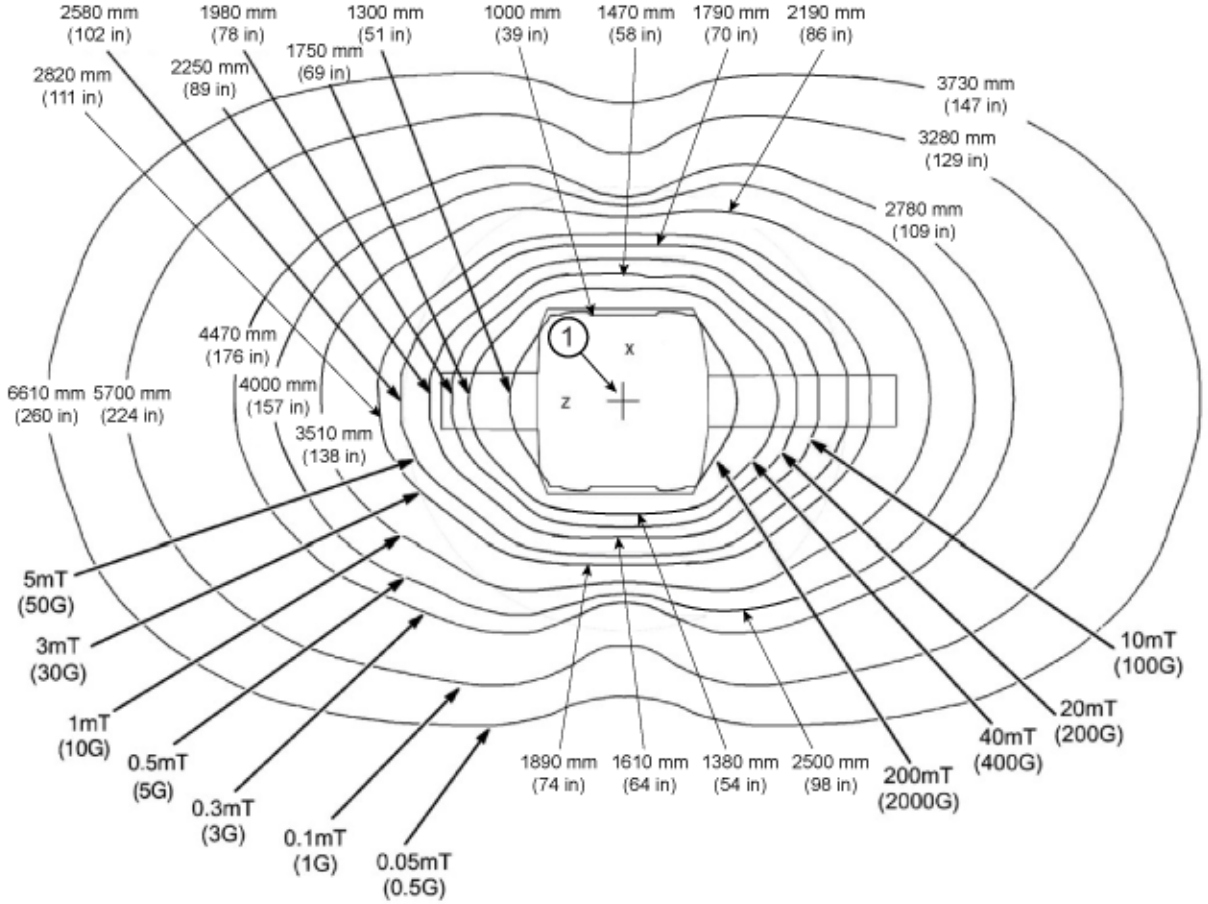
- Magnetic shielding
- Earth's magnetic field
- Other magnetic fields
- Stationary or moving metal

Figure 2-9 Magnetic Fringe Field Side View (LCC R series magnet)



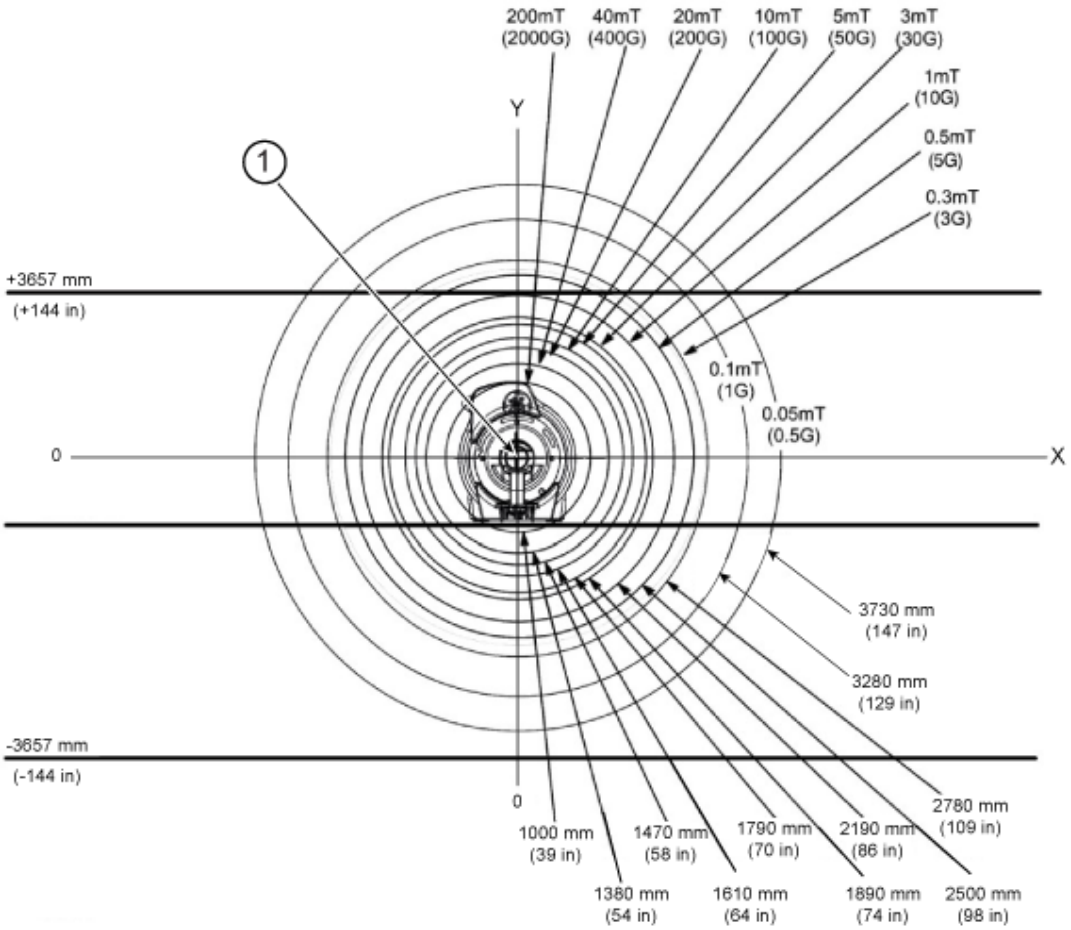
Item	Description
1	Magnet isocenter

Figure 2-10 Magnetic Fringe Field Top View (LCC R series magnet)



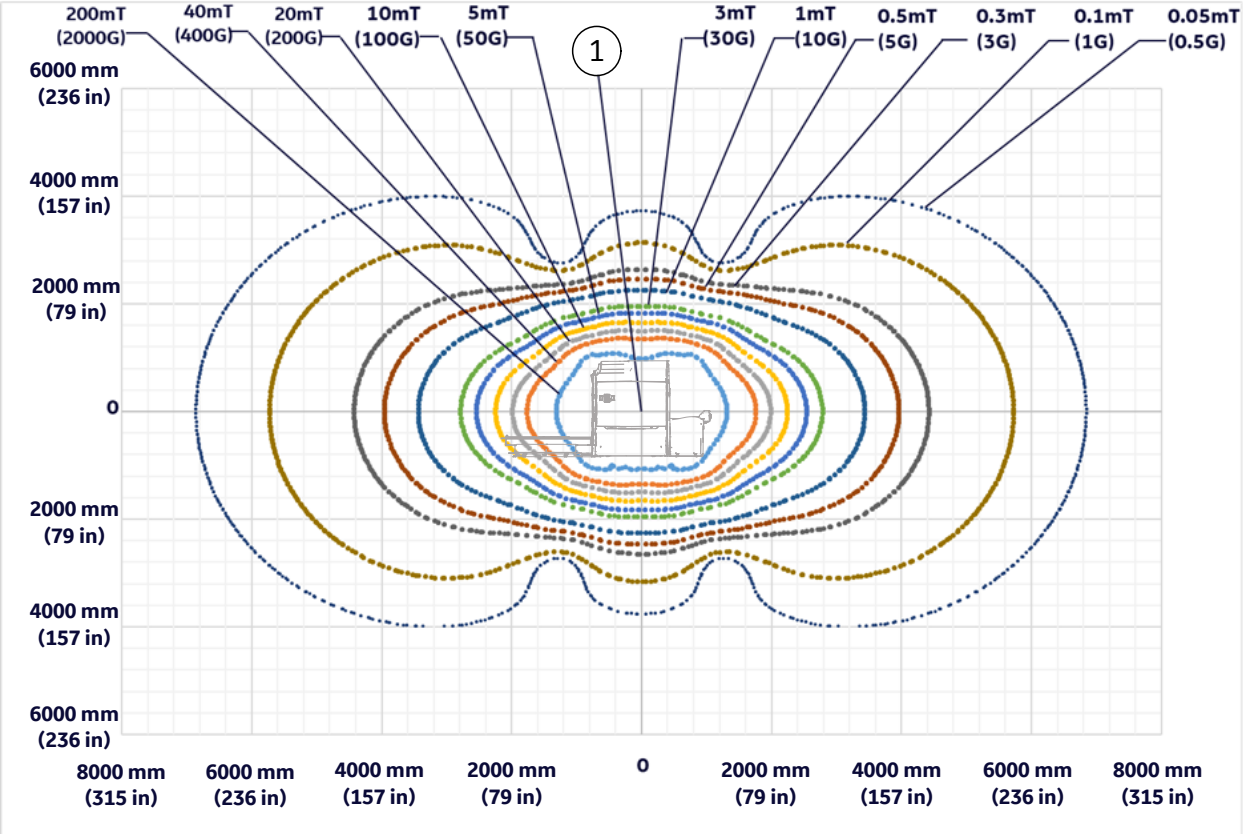
Item	Description
1	Magnet isocenter

Figure 2-11 Magnetic Fringe Field Front View (LCC R series magnet)



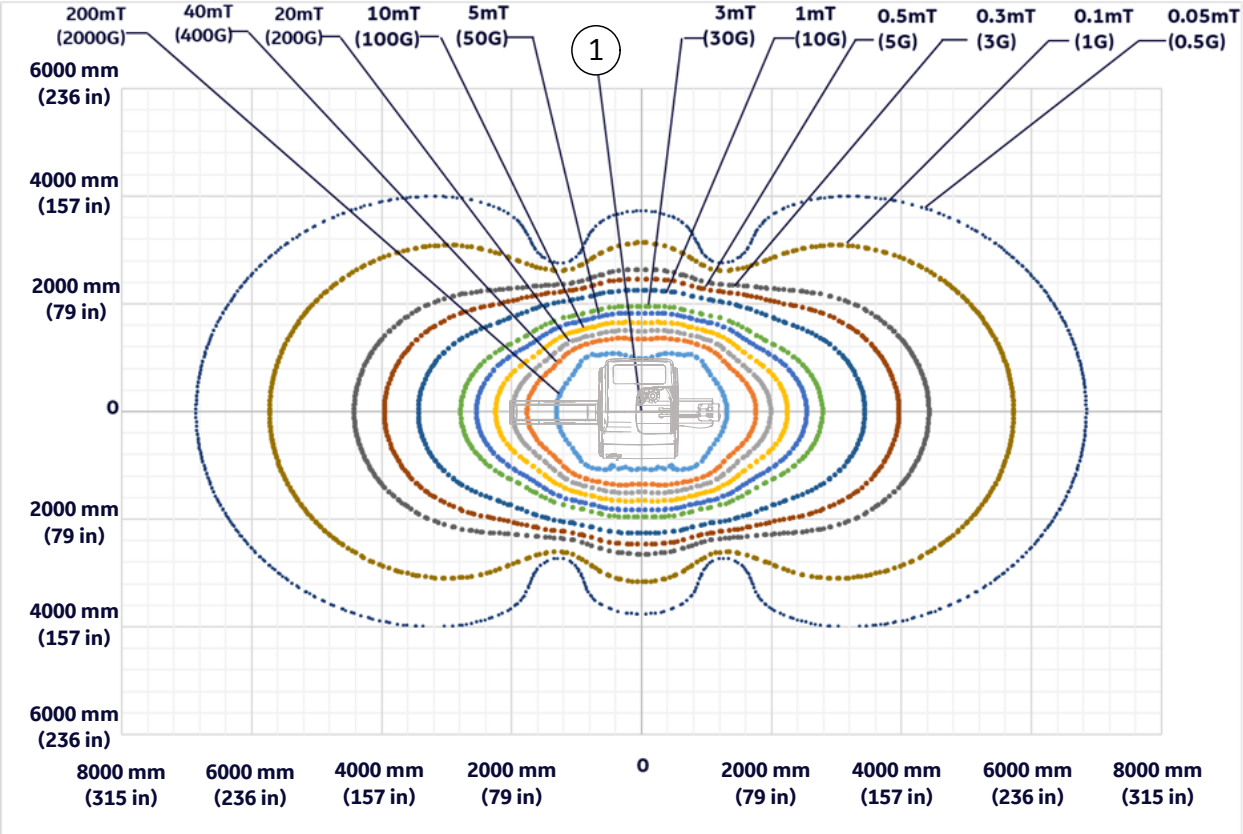
Item	Description
1	Magnet isocenter

Figure 2-12 Magnetic Fringe Field Side View (PM series magnet)



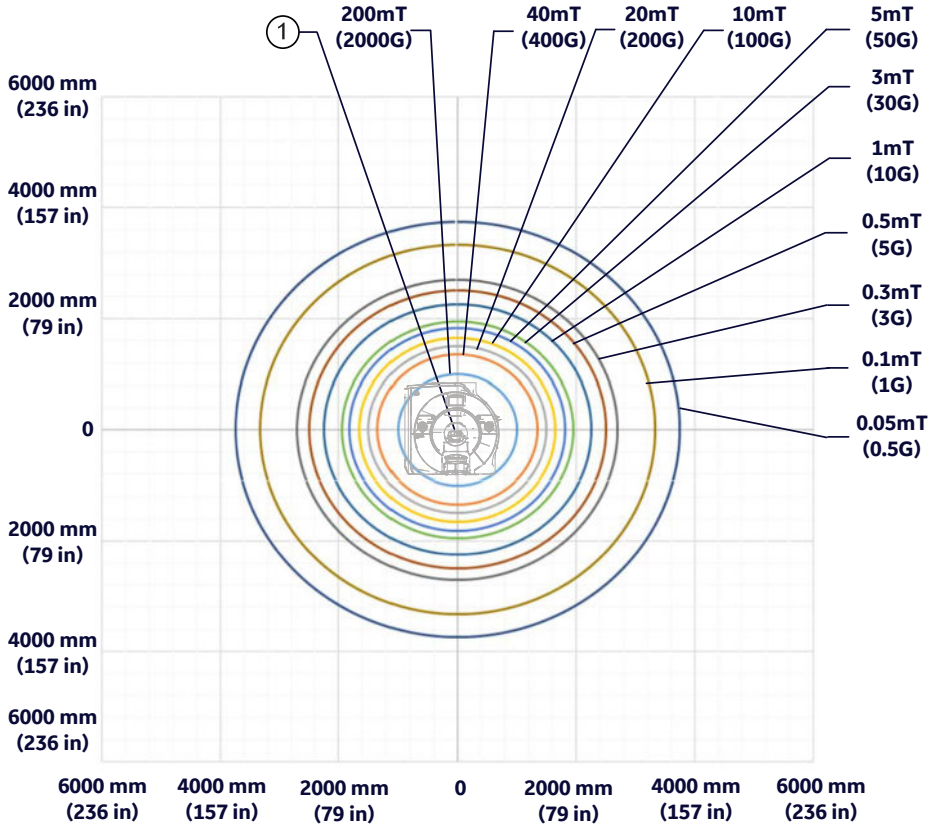
Item	Description
1	Magnet isocenter

Figure 2-13 Magnetic Fringe Field Top View (PM series magnet)



Item	Description
1	Magnet isocenter

Figure 2-14 Magnetic Fringe Field Front View (PM series magnet)

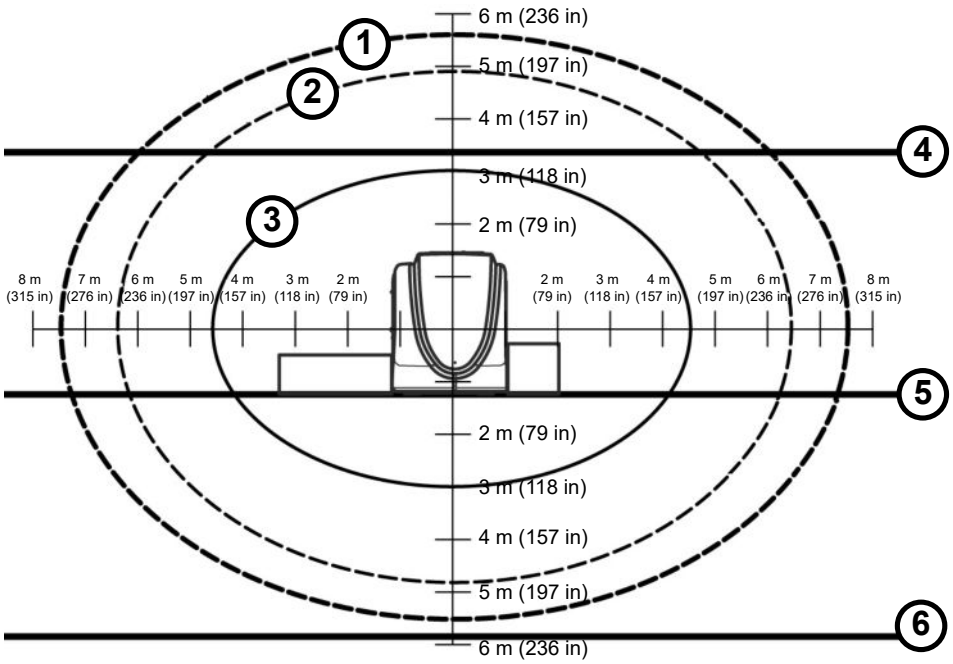


Item	Description
1	Magnet isocenter

2.6.2 Interference from Changing Magnetic Fields

Metal objects moving within the magnet sensitivity lines can produce a field disturbance during clinical imaging. If the metal object is moving it will produce a fluctuating dipole type of field which causes image artifacts. As an example, a car driven inside the moving metal line will act as a dipole and produce a time varying field which changes the magnet's main field during the scanning. The same vehicle may park within the moving metal line and remain parked during clinical scanning without impact to the main field.

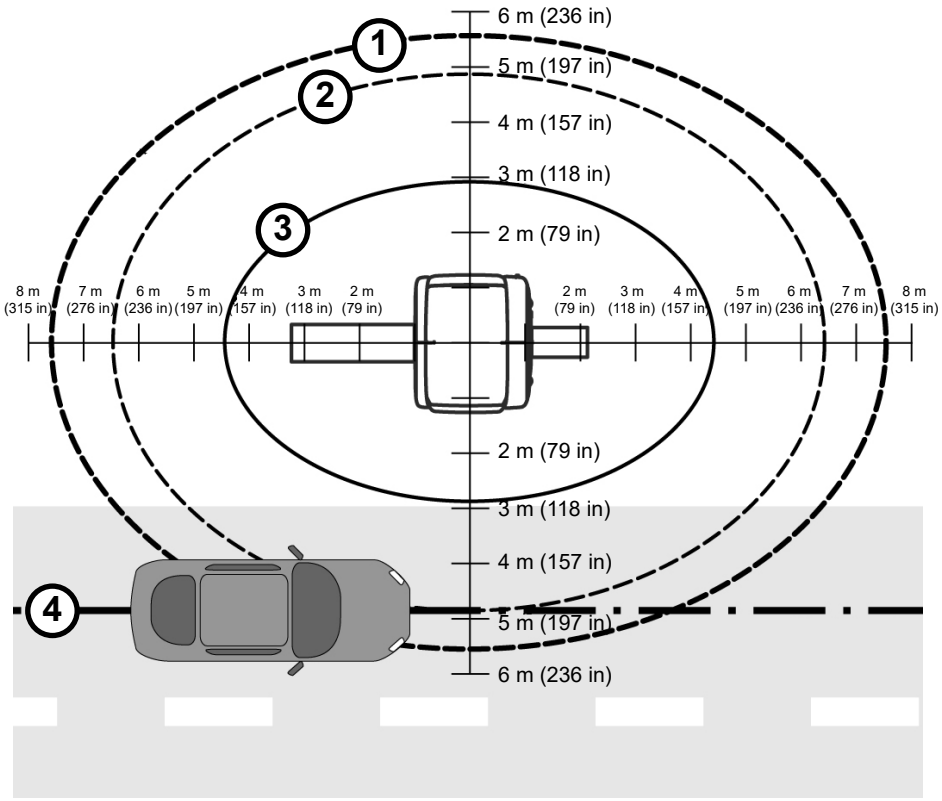
Figure 2-15 Magnet Moving Metal Sensitivity Line Plot (Side View, PM and R series magnet)



Item	Description	Item	Description
1	Trucks, Buses	4	Floor Above
2	Cars, Pickups, Vans, Ambulances	5	Magnet Room Floor
3	3 Gauss line	6	Floor Below

NOTE
The magnet isocenter, which is 1070 mm (42.1 in.) above the floor, is the origin of both the x-axis and the y-axis.

Figure 2-16 Magnet Moving Metal Sensitivity Line Plot (Top View , PM and R series magnet)



Item	Description	Item	Description
1	Trucks, Buses	3	3 Gauss line
2	Cars, Pickups, Vans, Ambulances	4	Center of Driving Lane

Table 2-3 Magnet Moving Metal Requirements

Metal Objects Category	Definition Of Distance Location	Magnet Minimum Distance Radial X Axial[1] m (ft.)
Objects 45.36 - 181.44 kg (100 - 400 lb.)	Distance from isocenter radial x axial	0.3 mT (3 G) line
Cars, Minivans, Vans, Pickup Trucks, Ambulances	Distance from isocenter measured to center of driving or parking lane radial x axial	4.72 x 6.40 (15.5 x 21)
Bus, Trucks (Utility, Dump, Semi)	Distance from isocenter measured to center of driving or parking lane radial x axial	5.52 x 7.47 (18.1 x 24.5)
Objects > 181.44 kg (400 lb.), Elevators, Trains, Subways	Place a directional probe (for example, flux gate sensor) at isocenter of proposed magnet location aligned along the Z-axis. Measure peak-to-peak magnetic field change (DC).	See Note 2 below

Table 2-3 Magnet Moving Metal Requirements (Table continued)

Metal Objects Category	Definition Of Distance Location	Magnet Minimum Distance Radial X Axial[1] m (ft.)

Notes:

1. Radial distances are magnet X and Y axis. Axial distances are magnet Z axis.
2. **For R series magnet:**

   EXAMPLE: For moving metal requirements of objects > 181.44 kg (400 lb.) category, you can use the time history of the occurrence to determine what Tesla (Gauss) level to use.

   2.1. If the site has elevators or counter weights near the magnet, and the elevator can stop on the floors for longer than 20 seconds (which is usually the case), the peak-to-peak reading (Z-axis disturbance) must be less than 443 nanotesla (4.43 milligauss).

   2.2. If the site has a subway nearby and the field disturbance is less than 5 seconds, the peak-to-peak reading (Z-axis disturbance) must be less than 443 nanotesla (4.43 milligauss).

   2.3. Use 443 nanotesla (4.43 milligauss) peak-to-peak.
3. **For PM series magnet:**

   EXAMPLE: For moving metal requirements of objects > 181.44 kg (400 lb.) category, you can use the time history of the occurrence to determine what Tesla (Gauss) level to use.

   3.1. If the site has elevators or counter weights near the magnet and the elevator can stop on the floors for longer than 20 seconds (which is usually the case), the peak-to-peak reading (Z-axis disturbance) must be less than 618 nanotesla (6.18 milligauss).

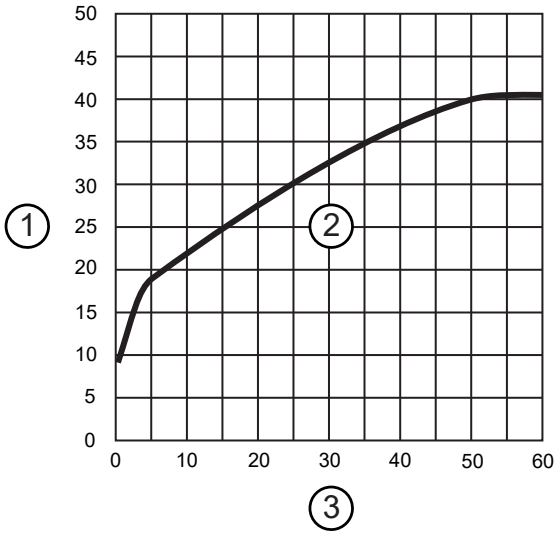
   3.2. If the site has a subway nearby and the field disturbance is less than 2 seconds, the peak-to-peak Tesla (Gauss) reading (Z-axis disturbance) must be less than 618 nanotesla (6.18 milligauss).

   3.3. Use 618 nanotesla (6.18 milligauss) peak-to-peak.

2.6.3 Electrical Current

1. Electrical current in high voltage power lines, transformers, motors, or generators near the magnet may affect magnetic field homogeneity.
2. Magnetic field interference at 50 or 60 Hz must not exceed 4 µT (40 mG) RMS at the magnet location (see Figure 2-17 Magnet Allowable Milligauss vs. Line Frequency for AC Equipment on page 36).
3. The following equation can be used as a general guide in determining allowable current in feeder lines at a given distance from the magnet isocenter:
   - 3.1. For 1.5T Magnet: $I = (20X^2)/S$
   - 3.2. I = Maximum allowable RMS single phase current (in amps) or maximum allowable RMS line current (in amps) in three phase feeder lines
   - 3.3. S = Separation (in meters) between single phase conductors or greatest separation between three phase conductors
   - 3.4. X = Minimum distance (in meters) from the feeder lines to isocenter of the magnet

Figure 2-17 Magnet Allowable Milligauss vs. Line Frequency for AC Equipment



Item	Description	Item	Description
1	Milligauss	3	Excitation Frequency (Hz)
2	No Impact on Imaging		

Refer to Sample Calculation AC Power Equipment Minimum Distance on page 130 for additional examples.

2.6.4 Non-MR System Equipment Sensitivity to Magnetic Fields

Site plans must include consideration for magnetic field interaction with all customer equipment.

This section lists equipment known to be sensitive to high magnetic fields.

Use the table for reference only. The Tesla (Gauss) limits in the table are approximate for that type of equipment. Refer to OEM manuals for the equipment at your site to determine the actual Tesla (Gauss) limits.

Table 2-4 Magnetic Proximity Limits (For Reference Only)

mT (Gauss) Limit	Equipment	
0.05mT (0.5 G)	Nuclear camera	
0.1mT (1 G)	Positron Emission Tomography scanner	Video display (tube)
	Linear Accelerator	CT scanner
	Cyclotrons	Ultrasound
	Accurate measuring scale	Lithotriptor
	Analog image intensifiers	Electron microscope
	Bone Densitometers	
0.3mT (3 G)	Power transformers	Main electrical distribution transformers
0.5mT (5 G)	Cardiac pacemakers	Biostimulation devices
	Neurostimulators	
1mT (10 G)	Magnetic computer media	Telephone switching stations
	Hard copy imagers	Water cooling equipment
	Line printers	HVAC equipment
	Video Cassette Recorder (VCR)	Major mechanical equipment room
	Film processor	Credit cards, watches, and clocks
	X-ray tubes	
	Large steel equipment, including:	
	Emergency generators	Air conditioning equipment
	Commercial laundry equipment	Fuel storage tanks
	Food preparation area	Motors greater than 5 horsepower
5mT (50 G)	Metal detector for screening	Telephones
	LCD panels	
No Limit	Digital Detectors	

2.7 Multiple MR System Requirements

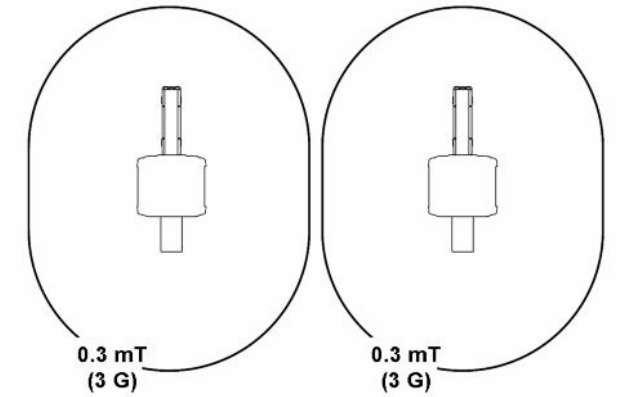
(Applies to all subsections within this section)

2.7.1 Multiple Magnets

When installing multiple magnets, the 0.3 mT (3 G) lines must not intersect or the magnets will be interactive. Contact the GE HealthCare Project Manager of Installation (PMI) for any questions regarding magnetic field interaction.

Magnet Rooms cannot share walls.

Figure 2-18 Two Magnet Installation (No Interaction)

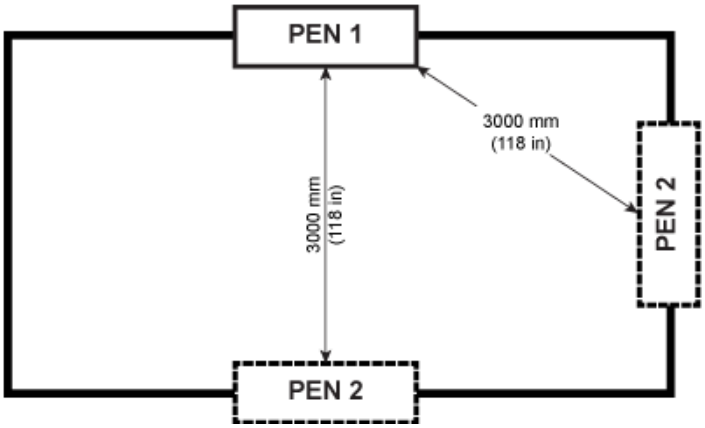


2.7.2 Shared Equipment Rooms

When installing multiple MR Systems in a shared Equipment Room, of the same field strength, the following conditions must be met:

1. The penetration panel of the other system must be separated from the penetration wall of the ISC by at least 3000 mm (118 in.).
2. Cables from different MR Systems must not be routed together.
3. Two systems cannot share common power or ground feeds.

Figure 2-19 Panel Separations in Shared Equipment Room (Top View)



2.8 MR Suite Temperature and Humidity

(Applies to all subsections within this section)

This section provides temperature and humidity requirements for the MR suite.

NOTE
Make sure the HVAC system has the correct capacity for the room size, equipment heat output, and environmental conditions to maintain correct temperature and humidity for the protection of the patient.

Specific construction requirements for each room can be found in the following chapters:

- Magnet Room
- Equipment Room
- Control Room

2.8.1 Temperature and Humidity Requirements

1. The customer is responsible for HVAC system design, purchase, and installation.
2. The temperature and humidity requirements must not be exceeded at any point during the day (both working or non-working hours).
3. A separate thermostat must be provided for the Magnet Room.

Table 2-5 Room Temperature and Humidity Requirements

Room	Temperature		Humidity	
	Range °C (°F)	Change °C/Hr (°F/Hr)[1]	Range %RH	Change %RH/Hr[2]
Equipment Room at Inlet to Equipment	15-28 (59-82.4)[3]	3 (5)	30-75	5
Magnet Room	15-21 (59-69.8)	3 (5)	30-60	5
Control Room	15-32 (59-89.6)	3 (5)	30-75	5

Notes:

1. Operating temperature gradient limits shall be between -3°C/Hr (-5°F/Hr) and 3°C/Hr (5°F/Hr), when averaged over 1 hour.
2. Operating humidity gradient limits shall be between -5% RH/hour and 5% RH/hour, when averaged over 1 hour.
3. Maximum ambient temperature is derated by 1°C per 300 m above 800 m (not to exceed 2600 m).

2.8.2 Equipment Heat Output Specifications

This section details the heat output for specific components. Actual heat output and room temperature may vary due to environmental factors, room insulation, clinical usage, and any non-GE HealthCare equipment used in the MR suite. Also, due to large variations in heat loads, the HVAC system may require unloaders, hot gas bypass, and reheat to maintain humidity levels.

IMPORTANT
To prevent condensation in the ISC and Gradient Coil in the Magnet Room, it is required to operate the air conditioner in the Magnet Room for 24 hours a day, 7 days a week.

Table 2-6 System Maximum Heat Output for Air Cooling

Component	Magnet Room W (BTU/hr)	Equipment Room W (BTU/hr)	Control Room W (BTU/hr)
Magnet (MAG)	1265 (4320)		
Integrated System Cabinet (ISC)		3814 （13009）	
18kW Chiller (LCS18) (Type D)		26100 (89057)	
Integrated Cooling Cabinet (ICC) (Type B)		1000 (3412)	
Magnet Monitor (MON)		60 (205)	
Cryocooler Compressor (CRY)		500 (1706)	
Main Disconnect Panel (MDP)		264 (900)	
Operator Workspace (OW)			1450 (4947)

NOTE
Although the air cooling load averaged over a 12-hour working day is approximately 1/2 of the maximum value, the HVAC system must be sized so that the maximum room gradient, temperature range, temperature change per hour, and humidity specifications per 2.8.1 Temperature and Humidity Requirements on page 40 are not exceeded at any point during the working day.

Table 2-7 System Options Heat Output for Air Cooling

Component	Magnet Room W (BTU/hr)			Equipment Room W (BTU/hr)			Control Room W (BTU/hr)		
	Maximum	Average	Idle	Maximum	Average	Idle	Maximum	Average	Idle
MR Elastography (MRE)				141 (480)					

2.9 Facility Coolant Requirements

(Applies to all subsections within this section)

IMPORTANT

Equipment Failure. A continuous supply of facility liquid coolant to the Cryocooler Compressor is required at all times for correct system operation. Failure to provide liquid coolant with the requirements listed in this section may cause equipment failure.

2.9.1 Integrated Cooling Cabinet (ICC) Coolant Requirements- Type B Configuration

1. The facility must provide an uninterrupted supply of liquid coolant to the Integrated Cooling Cabinet (ICC) at magnet delivery. Coolant circuit must be operational at magnet delivery.
2. The facility must provide pipe/hose, power cable (3 phase + ground) and clamps to the ICC.
3. The vertical distance between the coolant connection points of the ICC and the Gradient Coil must be less than ± 5 meters (± 196.8 in.).
4. It is recommended that the customer provide and install an in-line flow meter on either the supply or return facility coolant hose. The flow meter should capable of visually displaying volumetric flow between 30 and 60 L/min (7.9 and 15.9 GPM) and configured for the properties of the cooling fluid in use.
5. For sites without insite connectivity, it is recommended that the customer provide and install an in-line thermometer on the supply facility coolant hose. The thermometer should capable of visually displaying temperatures covering 5 to 15°C (41 to 59°F) and configured for the properties of the cooling fluid in use.
6. The ICC, Cryocooler Compressor and Integrated System Cabinet must be located on the same level.

Table 2-8 Facility Liquid Coolant Requirements

Parameter	Requirements
Availability	Continuous
Antifreeze or treated process water	No more than 50% propylene glycol-water (PGW) or ethylene glycol-water (EGW)
Minimum Flow	30 L/min (7.9 GPM)
Maximum Flow	60 L/min (15.9 GPM)
Nominal Flow	40 L/min (10.6 GPM)
Maximum Pressure Drop in ICC at 30 L/min	0.74 bar (10.7 psi) with 50% propylene glycol-water; 1060 kg/m^3 density 0.49 bar (7.1 psi) with pure water
Maximum Pressure Drop in ICC at 60 L/min	2.18 bar (31.6 psi) with 50% propylene glycol-water; 1060 kg/m^3 density 1.67 bar (24.2 psi) with pure water
Maximum Inlet Pressure to ICC	6 bar (87 psi)

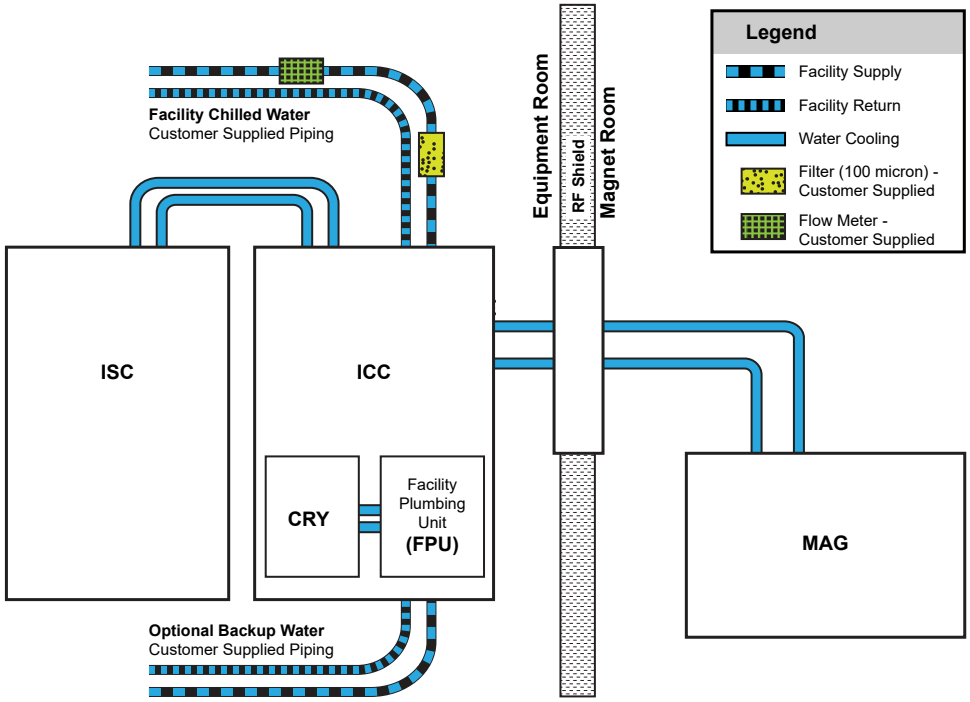
Table 2-8 Facility Liquid Coolant Requirements (Table continued)

Parameter	Requirements
Chiller Size	Minimum 20 kW
Condensation Protection	Facility Plumbing to the ICC must be properly routed and insulated to prevent equipment damage or safety hazards
Minimum Continuous Heat Load	7.5 kW
Inlet Temperature	5 to 15°C (41 to 59°F) measured at the inlet to the ICC
Customer supplied feeder hose (from main water supply to ICC)	19.1 mm (0.75 in.) minimum hose inside diameter If the hose is longer than 10 m (32.8 ft.) and shorter than 30 m (98.4 ft.), a hose with a 25.4 mm (1 in.) minimum ID is recommended. If using 25.4 mm (1 in.) hose, an adaptor is required to reduce the inner diameter to 19.1 mm (0.75 in.) for the ICC connection. **NOTE** Rigid pipe connections are not allowed.

Table 2-9 Facility Water Quality Requirements

Parameter	Requirement
pH Value	6.5 to 8.2 at 25 °C (77 °F)
Electrical Conductivity	< 0.8 mmho/cm
Chloride Ion	< 200 ppm
Sulfate Ion	< 200 ppm
M-Alkalinity	< 100 ppm
Total Hardness	< 200 ppm
Calcium Hardness	< 150 ppm
Ionic Silica	< 50 ppm
Iron	< 1.0 ppm
Copper	< 0.3 ppm
Sulfide Ion	None, not detectable
Ammonium Ion	< 1.0 ppm
Residual Chlorine	< 0.3 ppm
Free Carbon Dioxide	< 4.0 ppm
Stability Index	6.0 to 7.0
Suspended Matter	< 10 ppm
Particle Size	< 100 micron (with field changeable filter)

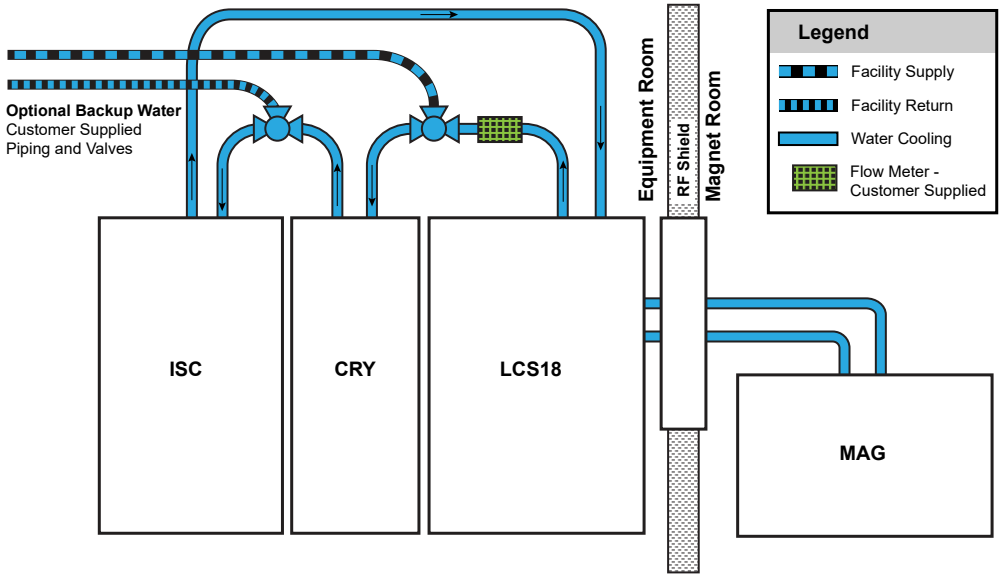
Figure 2-20 MR System Water Cooling Block Diagram



2.9.2 18KW Chiller Coolant Requirements- Type D Configuration

1. The vertical distance between the coolant connection points of the 18kw chiller (LCS18) and floor of the Magnet room must be less than ± 5 meters (± 196.8 in.).
2. The Chiller, Cryocooler Compressor and Integrated System Cabinet must be located on the same level.

Figure 2-21 Type D Chiller Configuration Block Diagram



2.9.3 Requirements for Emergency Backup Facility Coolant (Optional)

The customer must balance the cost of cryogens and local controls with the cost of emergency backup facility coolant. There are two options for emergency backup, either total ICC backup or Cryocooler Compressor backup.

The facility may provide an optional emergency backup coolant supply in one of the following configurations:

Customer provided temporary backup water cooling is allowed for the Shield/Cryo Cooler Compressor Cabinet if chiller or ICC were to experience a fault and stop operating. The backup compressor cooling design can utilize open loop city water only as temporary backup during loss of the closed loop water from the LCS18 or ICC. Long term use of open loop cooling systems will not allow a chemical equilibrium establishment and eventually contribute to failure.

NOTE
It is required to discharge remaining coolant in the compressor before switching back to the normal cooling. Dispose of coolant in accordance with local regulations.

1. Total ICC backup:

   1.1. The facility is responsible for the connection of all hoses of a backup system.

   1.2. Coolant must meet all other ICC coolant requirements listed in 2.9.1 Integrated Cooling Cabinet (ICC) Coolant Requirements-Type B Configuration on page 42.

2. Cryocooler Compressor backup only:

   Backup coolant may be routed to the ICC backup water port for the Cryocooler compressor at the location indicated in Figure 2-20 MR System Water Cooling Block Diagram on page 44 with the following requirements:

   (For Type B configuration) The ICC provides an emergency backup water interface on the right side of the cabinet. City water could be used as emergency backup water if the primary facility water system were to experience a fault.

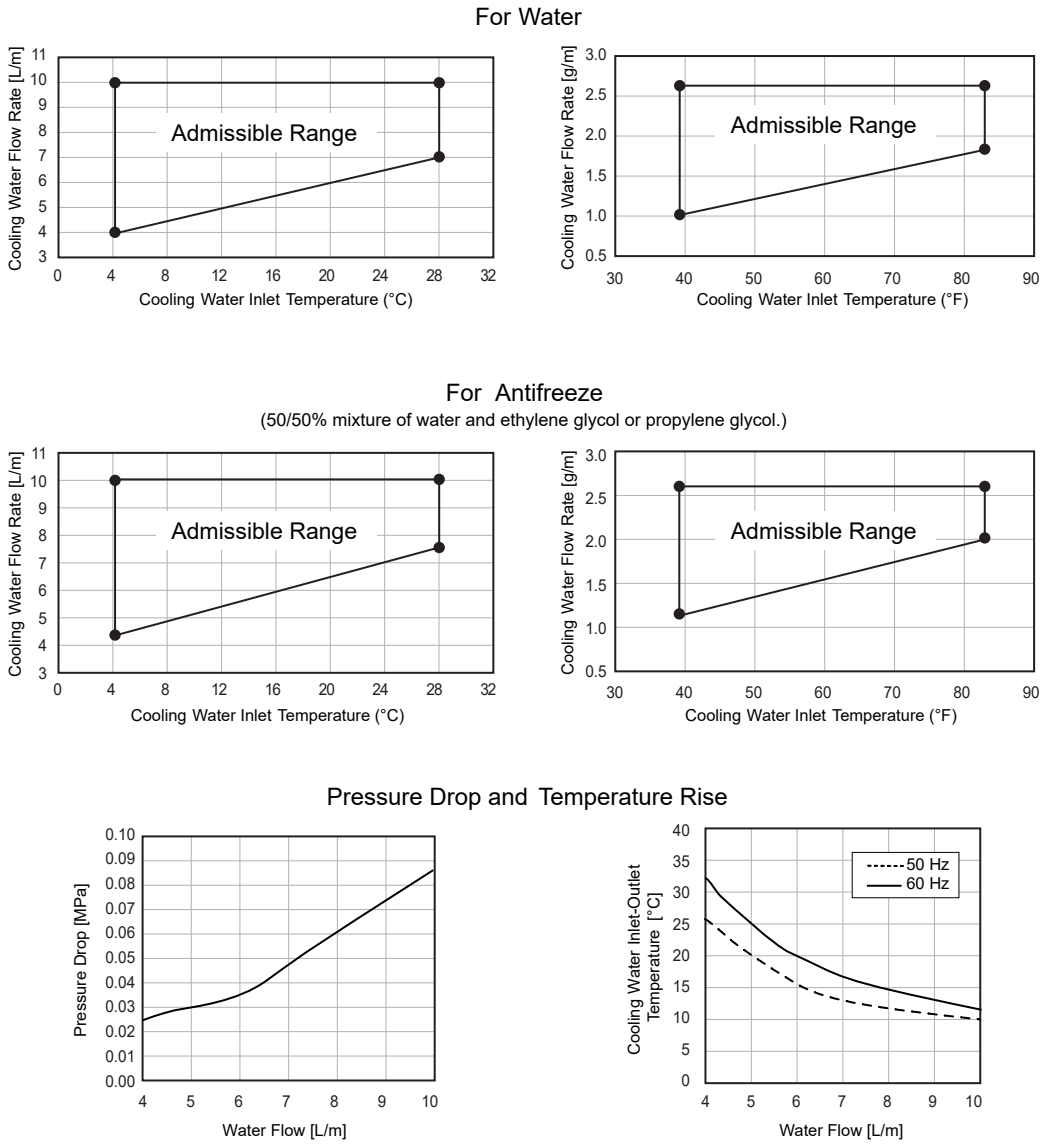
   2.1. The emergency coolant supply must be drained to the facility through customer supplied 12.5 mm (0.5 in.) hose and must not back-feed to the ICC.

   2.2. Coolant must meet all other ICC coolant requirements listed in 2.9.1 Integrated Cooling Cabinet (ICC) Coolant Requirements-Type B Configuration on page 42 .

   2.3. The customer is responsible for 12.5 mm (0.5 in.) pipe/hose, filters, and clamps to feed the backup coolant to the ICC emergency backup port.

   2.4. The charts below show the coolant flow rate and temperature requirements for the Cryocooler Compressor:

Figure 2-22 Cryocooler Water Cooling Requirements



(For Type D Configuration) The emergency backup water should be connected to the compressor directly.

Switching the Shield/Cryo Cooler Compressor inlet/outlet cooling from the 18 kW chiller to a temporary water backup supply will result in approximately 5.5 liters (1.5 gallons) of deionized water being discharged. This discharge may have site impacts due to local regulatory codes. Make sure to understand and follow local regulatory requirements when designing and implementing a temporary backup water system. The design of the change over equipment from 18 kW chiller to city water and vise versa must not allow contamination of the closed loop system in the 18 kW chiller.

1. Customer is responsible to provide the hoses, clamps and valves for emergency backup water to accommodate GE supplied hoses (inner diameter 12.5mm (0.5 in.), outer diameter 19.8mm (0.78 in.)).
2. Figure 2-22 Cryocooler Water Cooling Requirements on page 46 shows the coolant flow rate and temperature requirements for the Cryocooler Compressor.

3. City water, used as the emergency backup water, must not flow into the closed-loop cooling system when it returns to normal cooling configuration.

2.10 MR Suite Electrical Requirements

(Applies to all subsections within this section)

2.10.1 General Electrical Requirements

1. Customer is required to install a Main Disconnect Panel (MDP):
   1.1. For GE HealthCare supplied MDP, M50022MB and M50022MC Design setup, see 2.10.2 GE HealthCare Supplied Main Disconnect Panel (MDP) Specifications for M50022MB and M50022MC on page 50.
   1.2. For Customer-supplied MDP:
      1.2.1. Customer-supplied MDP may not be permissible in all regions. Contact your GE HealthCare Project Manager of Installation (PMI) to verify local requirements.
      1.2.2. MDP Design Requirements: 2.10.3 Customer-supplied Main Disconnect Panel (MDP) Requirements (exempt countries only*) on page 53.
      1.2.3. MDP Design Setup Figure 2-24 Customer-supplied MDP Setup on page 54.
2. At least one remote Emergency Off push-button shall be installed in a location that is visible and accessible to the device operator (Control Room or Magnet Room). The push-button shall be normally closed and require operator action to release after activation (for example, twist and pull). GE HealthCare recommends installing two remote Emergency Off push buttons, installed in the Control Room and Magnet Room.
3. The facility must provide system power to the MDP.
4. All associated transformers and cables must be correctly sized for system power requirements.
5. Runs E0009, E3500, and M3527 are supplied by GE HealthCare. All other wiring shown in 2.10.2 GE HealthCare Supplied Main Disconnect Panel (MDP) Specifications for M50022MB and M50022MC on page 50 and 2.10.3 Customer-supplied Main Disconnect Panel (MDP) Requirements (exempt countries only*) on page 53 must be customer supplied and installed. A customer-supplied substitute for E0009, can be used if the supplied run is shorter than required.
6. All feeder circuits require dedicated ground wires.

Table 2-10 Facility Power Requirements

Component	Parameter	Requirements	
At Main Disconnect Panel (MDP)	Voltage / Frequency	480 VAC	60 ±3 Hz
		415 VAC	50 ±3 Hz, 60 ±3 Hz
		400 VAC	50 ±3 Hz, 60 ±3 Hz
		380 VAC	50 ±3 Hz, 60 ±3 Hz
		208 VAC	50 ±3 Hz, 60 ±3 Hz
		200 VAC	50 ±3 Hz, 60 ±3 Hz

Table 2-10 Facility Power Requirements

Component	Parameter	Requirements	
	Daily Voltage Variation	Customer to provide +10% / -10% from nominal at MDP input under all line and load conditions. This includes variation of power source and transmission losses up to the MDP.	
	Phase	Input power to the MDP may use one of the following configurations: • A 3 phase solidly grounded WYE with Ground (3 Wire + Ground) A neutral conductor is not required for MR System operation. If a neutral conductor is present, it can be terminated on the neutral bus provided in the GE HealthCare-supplied MDP. • A 3 phase floating DELTA with Ground (3 Wire + Ground). Do not connect a corner grounded DELTA source. **NOTE** Some UPS options may require a neutral (refer to manufacturer documentation for requirements).	
	Phase Balance	Difference between the highest phase line-to-line voltage and the lowest phase line-to-line voltage must not exceed 2%	
	Power Quality	Recommended THD-V of less than 2.5%	
	Facility Zero Voltage Reference Ground	• The facility ground for the MR System must originate at the system power source (that is, transformer or first access point of power into the facility) and be continuous to the MR System Main Disconnect Panel (MDP) in the room. • Main facility ground conductor to Main Disconnect Panel (MDP) must be appropriately sized insulated copper wire. • The main facility ground to the Main Disconnect Panel (MDP) must meet local codes.	
	Power Availability	Continuous facility power is required at all times for operation of the Cryocooler (CRY) to minimize cryogen consumption.	
Service receptacle in Magnet Room	Voltage / Frequency	100-120 VAC 60 Hz (North America) 200-240 VAC 50/60 Hz (International)	Receptacle required for small power tools. Local voltage and portable transformers for voltage values.
	Phase	1	
	Maximum Current	20A (North America) 16A (International)	
Pneumatic Patient Alert (PA1)	Voltage / Frequency	100-120 VAC 60 Hz (North America) 200-240 VAC 50/60 Hz (International)	The Control Box must be mounted within reach of the operator and within 1.5 m (5 ft.) of an electrical outlet.
	Phase	1	
	Maximum Current	20A (North America) 16A (International)	
Magnet Rundown Unit (MRU)	Voltage / Frequency	100-120 VAC 60 Hz (North America) 200-240 VAC 50/60 Hz (International)	Connection type: Hardwired or permanently wired directly to facility power, no plugs or connectors allowed. 25 mm (1 in.) PVC Schedule 40 Conduit recommended Availability: Continuous

Table 2-10 Facility Power Requirements (Table continued)

Component	Parameter	Requirements	
	Phase	1	Circuit Breaker: Dedicated AC disconnect required for both live and neutral connections
	Maximum Current	1A	
Magnet Monitor (MON)	Voltage / Frequency	100-120 VAC 60 Hz (North America) 200-240 VAC 50/60 Hz (International)	Power at the outlet must be continuously available.
	Phase	1	
	Maximum Current	3A	
Optional MRE Resoundant Acoustic Driver	Voltage / Frequency	100-120 VAC 60 Hz (North America) 200-240 VAC 50/60 Hz (International)	
	Phase	1	
	Maximum Current	20A (North America) 16A (International)	
Oxygen Monitor (OXY) Option	Voltage / Frequency	100-120 VAC 60 Hz (North America) 200-240 VAC 50/60 Hz (International)	Connection type: Hardwired in unit
	Phase	1	
	Maximum Current	0.9A	

Table 2-11 System Power Demand

System Equipment	Power Draw (kVA) through MDP	
	Power Demand (Type B)	Power Demand (Type D)
ISC PDU Continuous Power	25	25
ISC PDU 50 Millisecond Power	30	30
ICC	3.7	-
18 kW Chiller	-	11.8
Cryocooler Compressor Continuous Power	9	9
Total system Continuous Power	37.7	45.8
Total System 50 Millisecond Power	42.7	50.8

2.10.2 GE HealthCare Supplied Main Disconnect Panel (MDP) Specifications for M50022MB and M50022MC

The customer is responsible for determining the suitability of the GE HealthCare supplied MDP with respect to governing electrical codes.

The GE HealthCare MDP consists of the following:

- A 3-pole main circuit breaker rated for the total current of all the sub-breaker circuits.

- A 3-pole circuit breaker rated for the current of the PDU circuit.
- A 3-pole circuit breaker rated for the current of the 18 kW Chiller/ICC circuit.
- A 3-pole circuit breaker rated for the current of the cryocooler compressor circuit.
- All circuit breakers have a short circuit current interrupting rating of 25000 Amps at 480V and Icc rating of 25000 Amps at 415V.
- Auto restart on the Cryocooler compressor and chiller circuit following loss and restoration of power.
- Two remote Emergency Off Buttons to be installed external to the MDP. Emergency Off removes power from all outputs when activated. MDP supports maximum E-off cable length of 100 meters when remote EPO push buttons are installed in the field.
- Terminal blocks that can accept wire sizes for M50022MB and M50022MC are listed under Table 2-13 GE HealthCare Supplied MDP - Range of Standard Conductors Accepted for M50022MB and M50022MC on page 52
- Provision for terminating facility incoming neutral wire on the neutral terminal block.
- Multiple ground terminal blocks as required by panel design.
- GE HealthCare MDP M50022MC is listed and labeled by Nationally Recognized Testing Lab (NRTL) in accordance with UL 508A and bears UL and CE mark. This MDP is certified as per UL 508A and IEC 61439-2 standards.
- GE HealthCare MDP M50022MB bears manufacturer's CE marking in accordance with the EU Low Voltage Directive 2014/35/EU and Electromagnetic Compatibility Directive 2014/30/EU and is certified as per IEC 61439-2 standards.
- Power on indicator for main breaker output power.
- Two isolated, normally open contact pairs that open when e-OFF is pressed or facility power is interrupted for use with optional accessories.
- Capability for single point lock-out/tag-out for the entire system (Mains Disconnect / Input Breaker) and a means to lock-out/tag-out each output breaker independently. All LOTO points support a standard sized hasp for lock-out.

Figure 2-23 GE HealthCare supplied Main Disconnect Panel (MDP) Setup

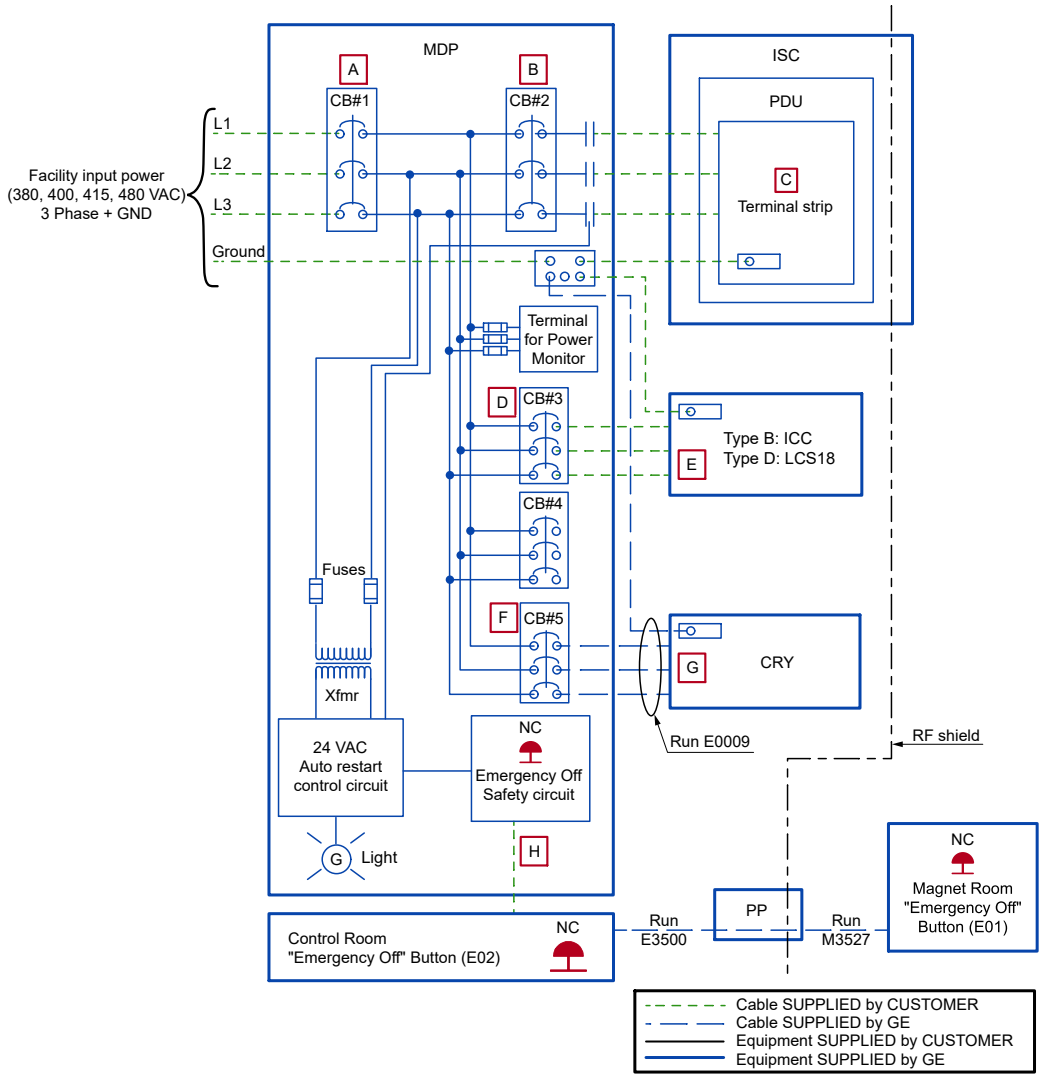


Table 2-12 GE HealthCare Supplied MDP Breaker Sizes

Circuit Breaker	Breaker Size
CB1	100A
CB2	60A
CB3	25A
CB5	25A

Table 2-13 GE HealthCare Supplied MDP - Range of Standard Conductors Accepted for M50022MB and M50022MC

Item	Phase		Ground	
	sq mm	AWG/kcmil	sq mm	AWG/kcmil
A	6-70	10-2/0	16-120	6-250
B	6-35	10-2	16-120	6-4/0
C	6-35	10-1	6-35	10-1

Table 2-13 GE HealthCare Supplied MDP - Range of Standard Conductors Accepted for M50022MB and M50022MC (Table continued)

Item	Phase		Ground	
	sq mm	AWG/kcmil	sq mm	AWG/kcmil
D	2.5-50	14-1/0	2.5-25	14-4
E (ICC)	2.5-6	14-10	2.5-6	14-10
E (Chiller)	4-6	12-8	4-6	12-8
F	2.5-50	14-1/0	2.5-25	14-4
G	2.5-6	14-10	2.5-6	14-10
H	0.5-2.5	22-12	N/A	N/A

2.10.3 Customer-supplied Main Disconnect Panel (MDP) Requirements (exempt countries only*)

NOTE
* The requirements listed below apply only to exempt countries. Please contact your GE HealthCare Project Manager of Installation (PMI) for the list of exempt countries.

WARNING

PERSONNEL INJURY OR EQUIPMENT DAMAGE

Customer supplied MDP must have correctly sized wires and rated components to meet the MR System Power Requirements.

NOTE
Refer to 8.5 Sample control schematic for customer-supplied MDP on page 133.

1. MDP shall provide Auto-Restart to the Cryocooler Compressor, Chiller and ICC.
2. Manual Restart Capability
   2.1. The MDP shall disconnect the PDU circuits upon power loss.
   2.2. The MDP shall require a manual restart on the PDU circuits when power is reapplied after an outage.
3. Emergency Off Circuit
   3.1. The MDP shall have an emergency off control circuit that disables power to the entire MR System.
   3.2. The emergency off circuit shall be actuated by a push button on the panel, and shall also be capable of being actuated by two remotely located push buttons.
   3.3. Manual reset of the emergency off circuit shall be required to restore power to the entire system.
4. The MDP shall include three breakers, as specified in Figure 2-24 Customer-supplied MDP Setup on page 54 and Table 2-14 Customer-supplied MDP - Required Breaker Sizes on page 55. Output breakers will feed the terminal block on ISC, 18KW chiller/ ICC and Cryocooler Compressor.

5. Lock-out/Tag-out:
   5.1. The MDP shall provide single point lock-out/tag-out for the entire system and a means to lock-out/tag-out each output breaker independently.
   5.2. The lock-out/tag-out feature shall accommodate a standard sized lock hasp.
   5.3. The lock-out/tag-out features shall be accessible from the outside of the panel, without the need to open the panel door(s).
6. The MDP shall have a Power ON indicator (Green light) on the panel.
7. The MDP shall meet national/local regulations.
8. The MDP shall provide terminations for all grounds entering, leaving and residing within the panel.
9. The MDP shall provide terminations of appropriate size for all power wiring entering and leaving the panel. Refer to Figure 2-24 Customer-supplied MDP Setup on page 54 All wire types, color, and sizing are to be selected in accordance with governing electrical codes.

Figure 2-24 Customer-supplied MDP Setup

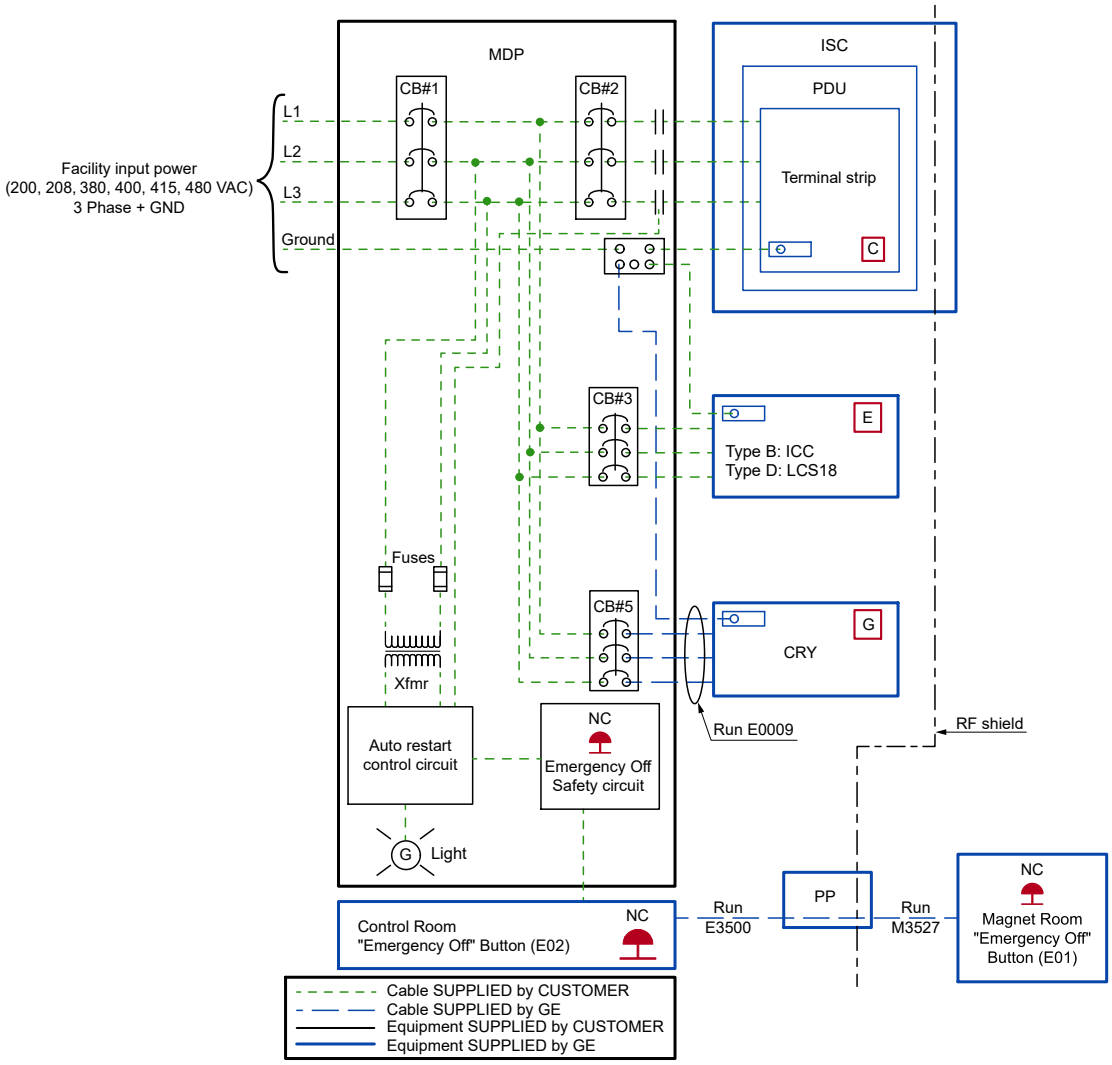


Table 2-14 Customer-supplied MDP - Required Breaker Sizes

Circuit Breaker	Breaker Size
CB1	100A
CB2	60A - 63A
CB3	25A
CB5	25A

Table 2-15 Customer Supplied MDP - Range of Standard Conductors Accepted

Item	Phase		Ground	
	sq mm	AWG/kcmil	sq mm	AWG/kcmil
C	6-35	10-1	6-35	10-1
E (ICC)	2.5-6	14-10	2.5-6	14-10
E (Chiller)	4-6	12-8	4-6	12-8
G	2.5-6	14-10	2.5-6	14-10

2.10.4 Emergency Power Backup Specifications (Optional)

The following facility backup power is recommended for continuous operation of the cryocooler compressor and Magnet Monitor:

NOTE
If the compressor must operate on emergency backup power, it still requires chilled water defined in the 2.9.3 Requirements for Emergency Backup Facility Coolant (Optional) on page 45.

- Dedicated, single power supply to the compressor
- Magnet Monitor emergency power (110V / 220V, 3A). Refer to Magnet Monitor (MON) Requirements and Specifications on page 104.
- Emergency Off Circuit (E-Off) for the emergency backup to the compressor. LOTO is required for the power source between the generator and compressor.
- A transfer switch to remove the primary power source from the compressor when in emergency backup power mode.

Table 2-16 Specifications for Emergency Power to Cryocooler Compressor

	F-50SH	F-50L
Power Line Voltage **WARNING** Do not use an inverter for the main power source.	AC 380, 400, 415V / 50 Hz, 3 phase (3 Wire + Ground) AC 460, 480V / 60 Hz, 3 phase (3 Wire + Ground) Commercial Power Source	AC 200V / 50, 60 Hz, 3 phase (3 Wire + Ground) Commercial Power Source
Operating Current	Max. 13A (Both 50 and 60 Hz)	Max. 23/26A (50/60 Hz)
Starting current	75/80A (50/60 Hz)	150/160A (50/60 Hz)
Minimum Circuit Ampacity	17A	32A

Table 2-16 Specifications for Emergency Power to Cryocooler Compressor (Table continued)

	F-50SH	F-50L
Maximum Fuse or Circuit Breaker Size	30A	50A
Power Requirement	Minimum 9 kVA Note: The manufacturer recommends a connection capable of 12 kVA.	Minimum 9 kVA
Power Consumption	Max. 8.3 kW / Steady State 7.5 kW at 60 Hz Max. 7.2 kW / Steady State 6.5 kW at 50 Hz	

2.11 MR System Shipping and Receiving

(Applies to all subsections within this section)

IMPORTANT
All shipping dimensions and weights are approximate and may vary based on ship-to location, required rigging, or other requirements. Some shipping or access routes may have requirements in addition to those listed in this section. Contact the GE HealthCare Project Manager of Installation (PMI) to verify magnet shipping, rigging, and access.

2.11.1 Receiving Requirements

1. The customer must provide an area for unloading system components from the truck and delivering to the MR suite

   NOTE
   Contact GE HealthCare project manager for magnet handling document to be used by rigging companies.

2. The customer is responsible for ensuring:

   2.1. All floors along the route will support the weight of the magnet (GE HealthCare recommends a structural analysis)

   2.2. Doors or other openings are sufficiently wide to allow passage

   2.3. Sufficient room is provided for any required rigging tools

2.11.2 Facility Delivery Route Requirements

The following table lists the delivery dimensions of system components. Upon delivery, verify the component dimensions and weight. The delivery route must be planned to accommodate the dimensions listed.

Table 2-17 Delivery Route Requirements

Component	Width		Height		Depth		Weight	
	mm	in.	mm	in.	mm	in.	kg	lb.
ISC	1100	43.3	2032	80	970	38.2	840	1852
Cryogen	Dimensions vary depending on dewar type used. Verify with cryogen supplier.							
Magnet	See 2.11.3 MR System Component Shipping Specifications on page 57.							
LCS18	See 18 kW Chiller dimensions in 4.8 18kW Water Chiller on page 100							
ICC	See ICC dimensions in Figure 4-7 Integrated Cooling Cabinet (ICC) on page 97							

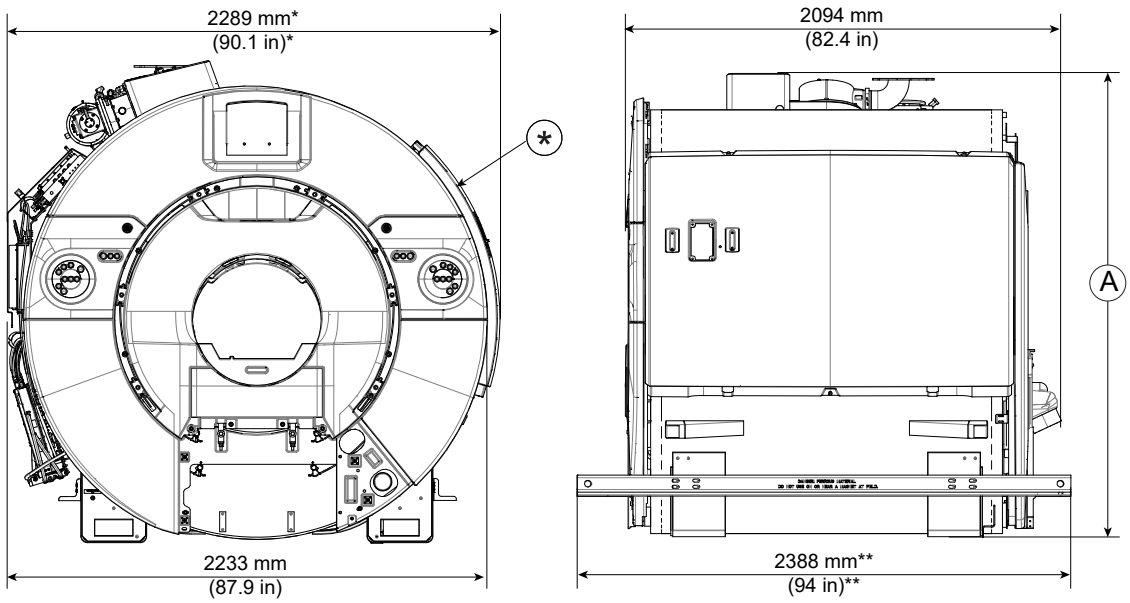
2.11.3 MR System Component Shipping Specifications

MR System component shipping dimensions and weight are listed below:

Table 2-18 MR System Component Shipping Specifications

Component	W x D x H		Weight		Notes
	mm	in.	kg	lb.	
PM Series Magnet (as shipped with lifting bars)	2289 x 2388 x 2238	90.12 x 94 x 88.1	4990	11100	Domestic with tarped wood frame
R Series Magnet (as shipped with lifting bars)	2289 x 2388 x 2238	90.12 x 94 x 88.1	5816	12822	Domestic with tarped wood frame
PM Series Magnet (Crated for International Shipping)	2438 x 2899 x 2438	96 x 114 x 96	5715	12600	
R Series Magnet (Crated for International Shipping)	2438 x 2899 x 2438	96 x 114 x 96	6541	14420	
Enclosure	2300 x 2180 x 1205	90.6 x 85.8 x 47.4	239	527	Pallet
	2440 x 1190 x 480	96.1 x 46.9 x 18.9	106	234	Pallet
LCS18	1350 x 1100 x 2090	53.2 x 43.3 x 82.3	450	992	Crate
	1200 x 1020 x 750	47.2 x 40.2 x 29.5	50	110	Accessory *Carton
	1050 x 650 x 700	41.3 x 25.6 x 27.6	35	77	Accessory *Carton
	650 x 650 x 870	25.6 x 25.6 x 34.3	105	231	Accessory *Carton
ISC	1420 x 1160 x 2300	55.9 x 45.7 x 90.6	1020	2249	Crate
ISC Accessory	1870 x 1230 x 1190	73.6 x 48.4 x 46.9	146	322	Carton
ICC	1150 x 1150 x 2188	45.3 x 45.3 x 86.1	400	882	Crate
GOC	850 x 550 x 790	33.5 x 21.7 x 31.1	84	185	Carton
SPT Phantom Set	864 x 826 x 1524	34 x 32.5 x 60	159	350	On cart casters with box cover
Rear Pedestal	1170 x 850 x 1330	46.1 x 33.5 x 52.4	122	269	Carton
Interconnect Kit	1400 x 850 x 1020	55.1 x 33.5 x 40.2	148	326	Carton
Low Height Fixed Patient Table	2380 x 680 x 1034	93.7 x 26.8 x 40.7	250	551	Pallet
Cryocooler Compressor	660 x 711 x 1067	26 x 28 x 42	125	275	Pallet with box cover

Figure 2-25 Magnet Dimensions (as Shipped)



Item	Description
A	**(For R series magnet)** : Domestic shipment: 2327 mm (91.6 in) International shipment: 2243 mm (88.3 in) **(For PM series magnet)** : Dimension is 2238 mm (88.1 in)

NOTE

* Width can be reduced by 56mm (2.2 in.) if right center enclosure is removed.

** The short beam length is 2000 mm (78.7 in) and is available as P/N 5796140.

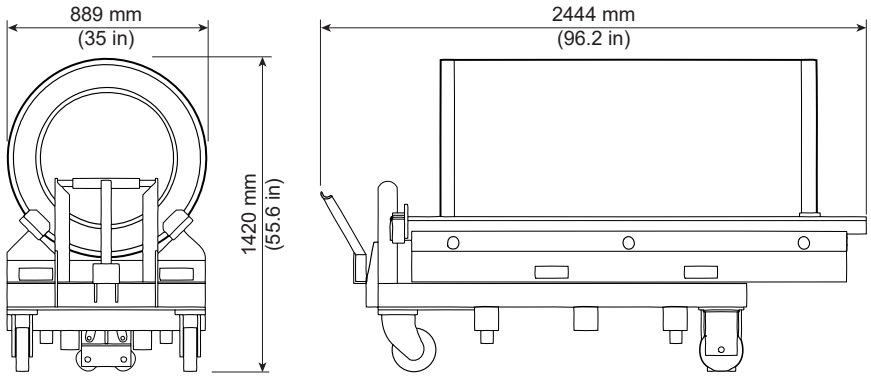
Table 2-19 MR System Component Replacement Shipping Specifications

Component	Component Location	W x D x H		Weight	
		mm	in.	kg	lb.
Replacement RF Body Coil	Magnet Room	762 x 762 x 1524	30 x 30 x 60	70	155
Replacement BRM Gradient Coil Assembly on a Shipping Cradle/Cart	Magnet Room	889 x 2444 x 1420	35 x 96.2 x 55.6	1491	3287
Gradient Amplifier	Equipment room (front of ISC)	910 x 680 x 481	35.8 x 26.8 x 18.9	81	180
Gradient Amplifier Power Supply	Equipment room (front of ISC)	1004 x 483 x 634	39.5 x 19 x 25	154	340
Gradient Coil Replacement Tool Kit Crate	At site near magnet room	787 x 2184 x 952	31 x 86 x 37.5	340	750

NOTE

The dimensions and weights listed for the components in Table 2-19 MR System Component Replacement Shipping Specifications on page 59 include packaging.

Figure 2-26 Gradient Coil Cart



2.11.4 Temperature and Humidity Storage Requirements

MR systems and components must be stored within the environmental requirements listed below.

NOTE
Some equipment is liquid-cooled. After coolant is added, the equipment must be kept from freezing. Phantoms and the coolant itself must also be kept from freezing.

Table 2-20 Transportation and storage environmental conditions for system components

Temperature		Humidity	
Range °C (°F)	**Change °C/Hr (°F/Hr)**	**Relative % (Non-condensing)**	**Change %/Hr**
-30 — 55 (-22 — 131)	20 (68)	10 — 90	30

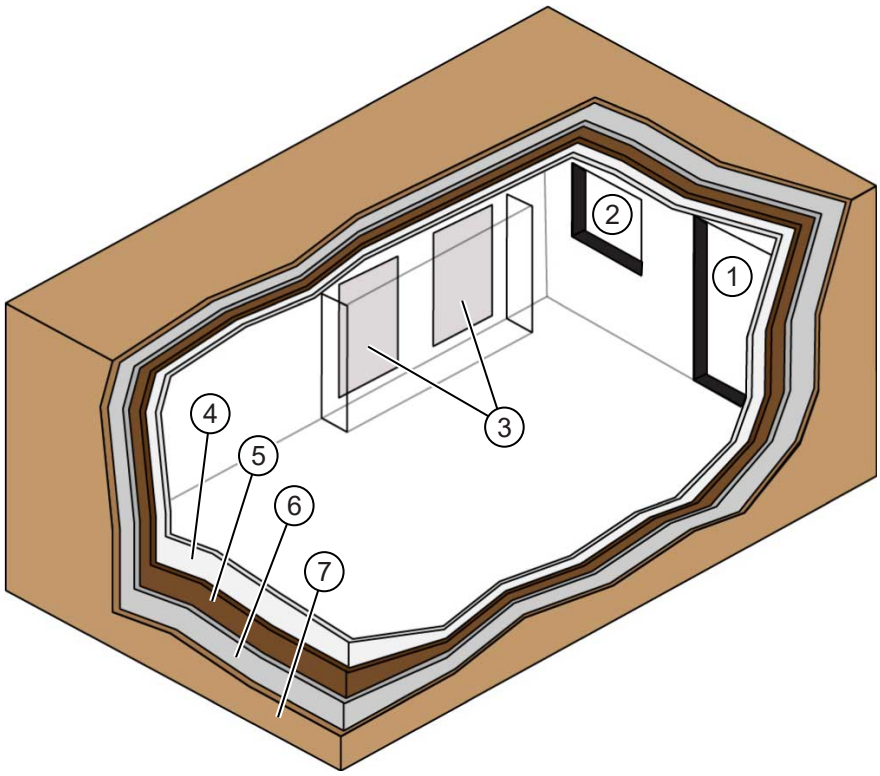
3 Magnet Room

3.1 Magnet Room Introduction

The Magnet Room is best understood as a series of layers, or “rooms within a room.” Each of these rooms has a specific function and associated requirements. All requirements in this chapter must be followed to ensure safe and correct operation of the MR System.

1. The Magnetic shielded room contains the MR Magnet fringe field within a confined space. A site survey is required to determine magnet shield requirements (not all sites require magnetic shielding). Because of the added cost of magnetic shielding, room location should be carefully considered.
2. The Acoustic room is a layer used to help attenuate the noise produced during a scan. An acoustic engineer is strongly recommended to assess the environment.
3. The RF shielded room is critical to the correct MR System operation. RF shielding prevents interaction of external RF radiation with MR System operation and it also prevents MR System RF radiation from interfering with external systems, such as aircraft control. Special care must be used when installing all fixtures penetrating the RF shield (for example, vents, electrical conduit, penetration panels) to ensure the integrity of the RF shield is maintained. Refer to *RF Shielded Room Requirements*, 5850260-1EN.
4. The Finished room includes the wall coverings, ceiling tile, ceiling grid, other fixtures, Magnet (MAG) and Patient Table (PT). When planning the finished room, ensure the following:
    - 4.1. All building codes are met (such as maintaining egress routes).
    - 4.2. Items which may generate or create RF interference (including fluorescent lighting) are not allowed for installation within the Magnet Room.
    - 4.3. Customer is responsible for the selection and installation of all locally required safety devices (for example, smoke detectors, oxygen monitors, and so on).
    - 4.4. Smoke detectors should be located outside of the Magnet Room (for example, within the return air duct) whenever possible. If code does not allow this, use only simple two wire non-addressable smoke detectors in the Magnet Room.
    - 4.5. Ferrous or metallic items which could become projectiles when the magnet is installed (including wall coverings, ceiling tile, ceiling grid, or other fixtures) are not used or are correctly secured.

Figure 3-1 Magnet Room Layers



Item	Description	Item	Description
1	Door	2	Window
3	Penetration wall(s)	4	Finished room
5	RF shielding	6	Acoustic barrier
7	Magnetic shielding		-

NOTE
The sequence of the room layers can vary based on siting needs.

3.2 Magnet Room Structural Requirements

This section lists the structural requirements that must be considered when performing site evaluation and planning of the Magnet Room.

3.2.1 Overview

1. When preparing a building plan or evaluating a potential site for an MR System, take care to ensure the MR suite will not interact with the surrounding environment (that is, magnetic, acoustic, environmental steel, and vibration).
2. The customer is responsible for vibration testing required to verify suitability of a proposed site. All test results and any questions regarding testing, results, or analysis must be forwarded to the GE HealthCare Project Manager of Installation (PMI).

3.2.2 Environmental Steel Limits

A static magnetic field extends in a three-dimensional space around the magnet isocenter. Environmental steel within the static magnetic field affects the uniformity (or homogeneity) of the field. Field uniformity is critical to both image quality and chemical shift analysis (spectroscopy). An analysis of the environmental steel is required within a 3 m (9.84 ft.) spherical radius of the magnet isocenter. Environmental steel includes pipes, beams, concrete rebar, or any other structural steel in the floors, walls, or ceiling.

The following floor items must be limited per Table 3-1 Steel Mass Limits to Magnet Isocenter (3 x 3 m (10 x 10 ft.) Area Under Magnet) on page 65.

1. Non-movable steel construction material such as rebar and metal decking
2. Existing or proposed RF/magnetic shielding or shim plates
3. Table 3-1 Steel Mass Limits to Magnet Isocenter (3 x 3 m (10 x 10 ft.) Area Under Magnet) on page 65 defines the limits of use as a guideline to help the customer understand allowable amounts of ferrous rebar, steel decking, or other components as they design the MR suite and Magnet Room floor structure.
4. The customer must provide detail defining ferrous material below the magnet to the Project Manager so the GE HealthCare MR Siting and Shielding (MRSS) team can review for compliance.

Table 3-1 Steel Mass Limits to Magnet Isocenter (3 x 3 m (10 x 10 ft.) Area Under Magnet)

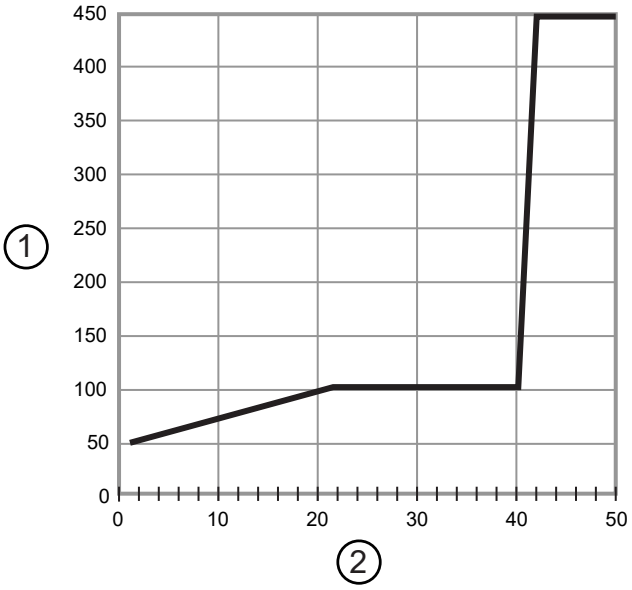
Limits Of Steel Mass kg/m^2 (lb./ft^2)	Distance Below Top Surface Of Floor mm (in.)
0 (0)	0-76 (0-3)
9.8 (2)	76-127 (3-5)
14.7 (3)	127-254 (5-10)
39.2 (8)	254-330 (10-13)
98.0 (20)	330+ (13+)

3.2.3 Vibration Requirements

Excessive vibration can affect MR image quality. Vibration testing must be performed early in the site planning process to ensure vibration is minimized. Both steady state vibration (exhaust fans, air conditioners, pumps, and so on) and transient vibrations (traffic, pedestrians, door slamming, and so on) must be assessed (see Figure 3-2 Magnet Steady State Vibration Specificationsfor R series magnet on page 66 and Figure 3-3 Magnet Steady State Vibration Specifications for PM series magnet on page 66). Specific requirements for vibration mitigation, include:

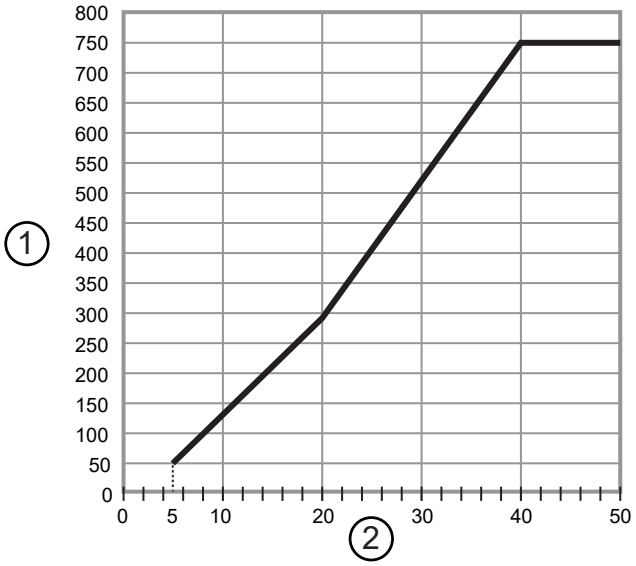
1. The Magnet (MAG) cannot be directly isolated from vibration. Any vibration issue must be resolved at the source.
2. MR Suite HVAC must have vibration isolation.
3. A vibration analysis must be performed at the proposed site with the results (and any mitigation) forwarded to the GE HealthCare Project Manager of Installation (PMI). See the 8.2 MR Site Vibration Test Guidelines on page 126.
4. A transient vibration test must only be performed after a steady-state test has been performed and all steady-state sources of vibration have been mitigated.
5. Transient vibration levels above the specified limits in the 8.2 MR Site Vibration Test Guidelines on page 126 must be given to the PMI for review.
6. Any transient vibration that causes vibration to exceed the steady-state level must be mitigated.
7. The vibration test consultant must account for non-mechanically induced signals such as test equipment instabilities, thermal drift or RF interference.

Figure 3-2 Magnet Steady State Vibration Specificationsfor R series magnet



Item	Description
1	Acceleration (g x 10^{-6}) (RMS) above ambient baseline
2	Excitation frequency (Hz)

Figure 3-3 Magnet Steady State Vibration Specifications for PM series magnet



Item	Description
1	Acceleration (g x 10^{-6}) (RMS) above ambient baseline
2	Excitation frequency (Hz)

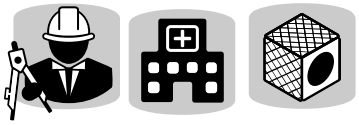
3.3 Magnetic Shielded Room Requirements

Magnetic shielding prevents interaction between the magnet and nearby sensitive devices. Because of the added cost of magnetic shielding, room location should be carefully considered. All sites, including upgrade sites, must be evaluated for magnetic shielding requirements. Existing magnetic shielding at an upgrade site may not be sufficient for the new system. Contact the GE HealthCare Project Manager of Installation (PMI) to request a site evaluation.

See MR Suite Magnetic Field Specifications on page 26 for detailed magnetic proximity limit information.

1. The GE HealthCare Project Manager of Installation (PMI) works with the customer to coordinate the magnetic shielding site evaluation.
2. The customer is responsible for installation of all magnetic shielding.
3. If rear wall magnetic shield or steel RF wall is closer than 2500mm (98.4 in.) from isocenter, it should be verified by GE HealthCare PMI.

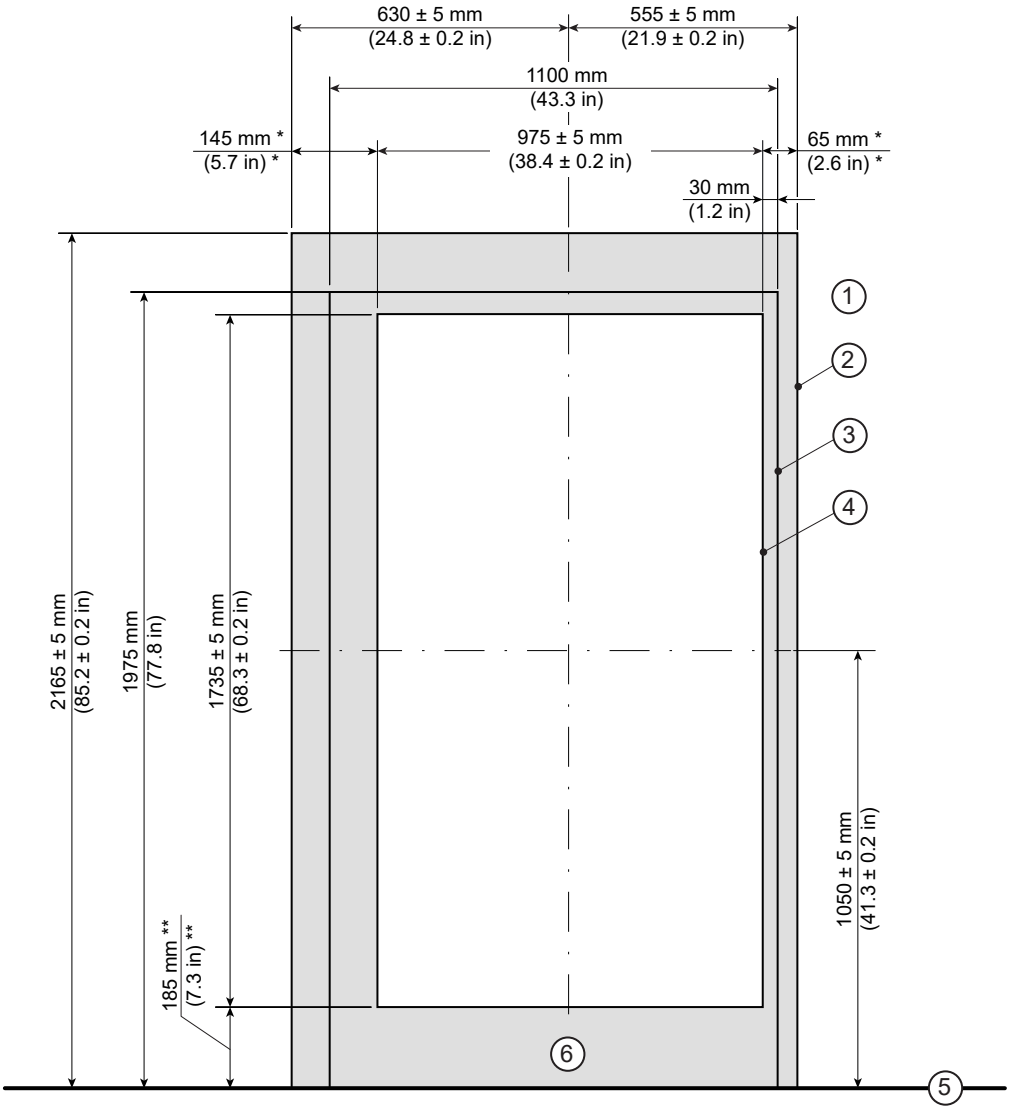
3.4 Integrated System Cabinet (ISC) and Penetration Panel (PP) Wall Opening Requirements



The Penetration Panel must be covered on both sides and ISC must be covered on the magnet room side for safety. If GE-supplied adjustable covers are not used, the customer must furnish covers or enclosures with key or tool required for opening to limit access to the panel. The mounting and clearance dimensions for the Penetration Panel and the ISC are shown in this section.

Figure 3-4 Wall Opening Detail for ISC (Equipment or Operator Room Side) on page 68 shows wall cutoff detail for the ISC (Equipment or Operator Room side).

Figure 3-4 Wall Opening Detail for ISC (Equipment or Operator Room Side)



Item	Description	Item	Description
1	Finished Wall	4	Wall Cut Out
2	Finished Wall Cut Out	5	Equipment Room Finished Floor
3	ISC Cover Outline	6	Exposed area of RF Shield (Gray Color Area)

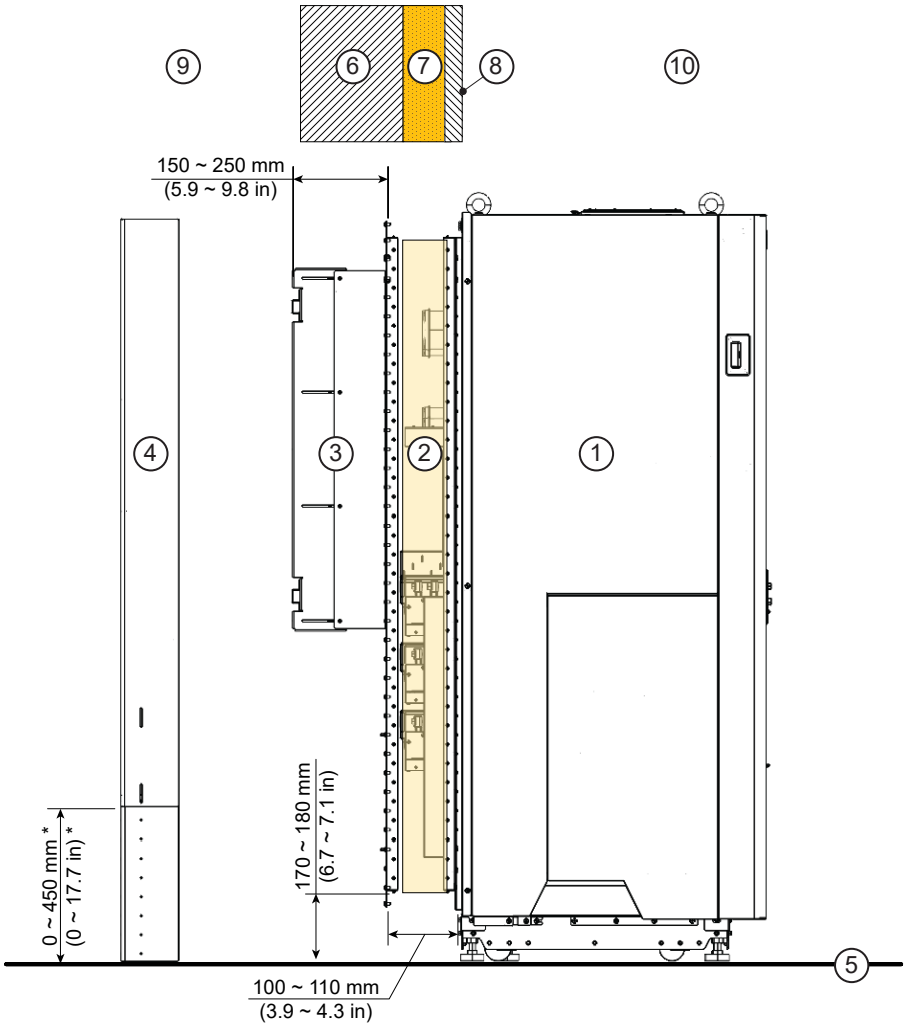
NOTE

* This value is the length when the wall cutoff width is 975 mm (38.4 in.).

** This value is the length when the wall cutoff height is 1730 mm (68.11 in.).

Cabinet left side has cooling plumbing assembly. Wall cut out area is not symmetric with cabinet center.

Figure 3-5 RF Shield



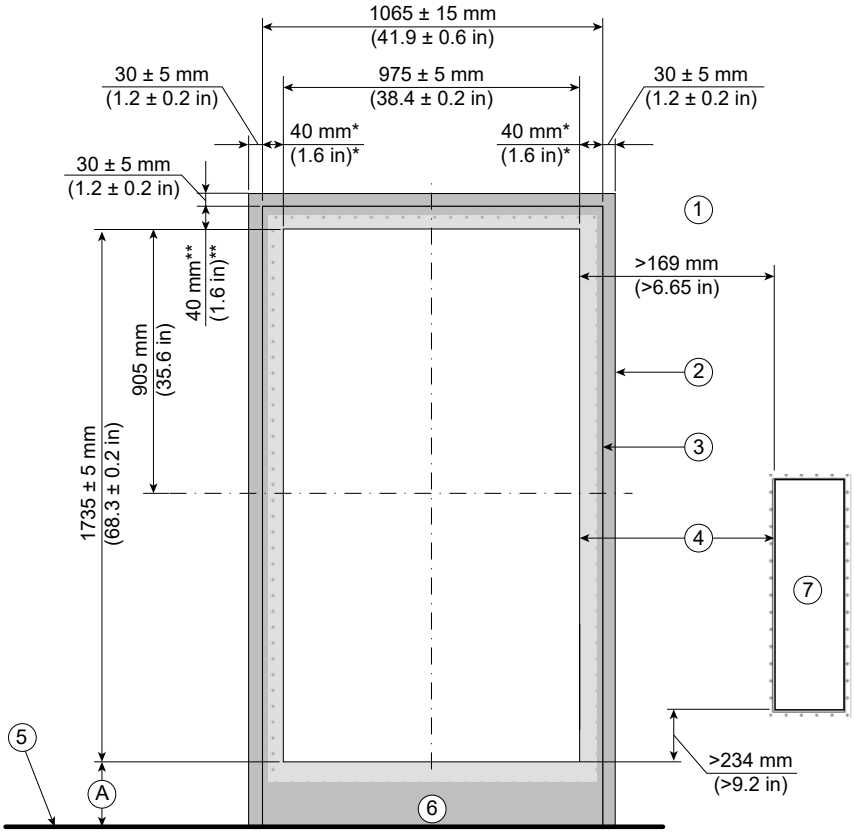
Item	Description	Item	Description
1	ISC	6	Magnet Room Finished Wall
2	Mesh Shield	7	RF Shield Wall
3	ISC Back Cover Support	8	Equipment Room Finished Wall
4	ISC Back Cover	9	Magnet Room
5	Equipment Room Finished Floor	10	Equipment Room

NOTE
* Cables exit the enclosure in this area. Cover height is adjustable. Dimension is referenced from the equipment room finished floor.

NOTE
The single-point ground bar is prepared by the customer. Locate it according to the *Grounding Requirements in RF Shielded Room Requirements, 5850260*.

Figure 3-6 Wall Opening Detail for ISC (Magnet Room Side) on page 70 shows wall cutoff detail for the ISC (Magnet Room Side).

Figure 3-6 Wall Opening Detail for ISC (Magnet Room Side)



Item	Description	Item	Description
A	The value depends on the height from Equipment Room floor	4	Wall Cut Out
1	Finished Wall	5	Magnet Room Finished Floor
2	Finished Wall Cut Out	6	Exposed area of RF Shield (Gray Color Area)
3	ISC Cover Outline	7	Penetration Panel (Can be located on the left or on the right side of the ISC)

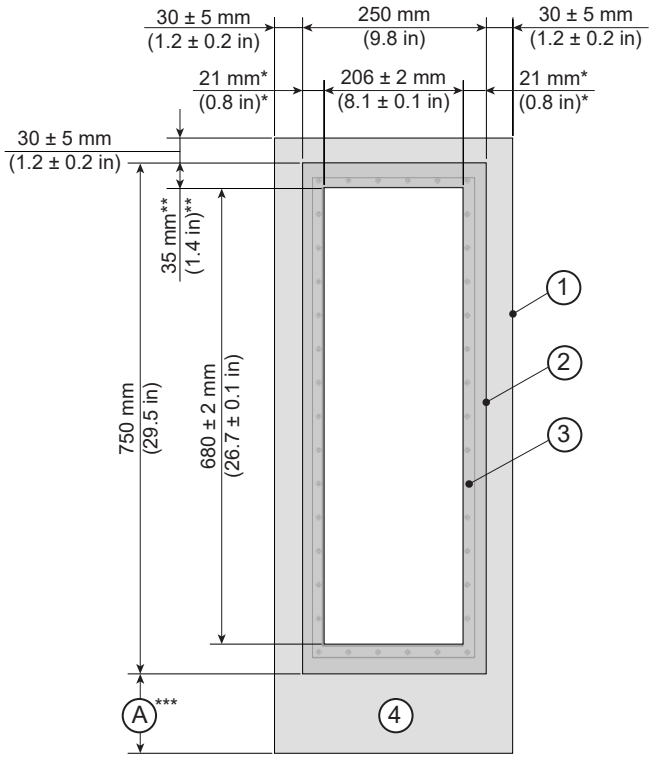
NOTE

* This value is the length when the wall cutoff width is 970 mm (38.2 in.).

** This value is the length when the wall cutoff height is 1730 mm (68.11 in.).

Figure 3-7 Wall Opening Detail for Penetration Panel (PP) on page 71 shows wall cutoff detail for the Penetration Panel from both room sides.

Figure 3-7 Wall Opening Detail for Penetration Panel (PP)



Item	Description	Item	Description
1	Finished Wall Cut Out	3	Wall Cut Out
2	Cover Outline	4	Exposed area of RF Shield

NOTE

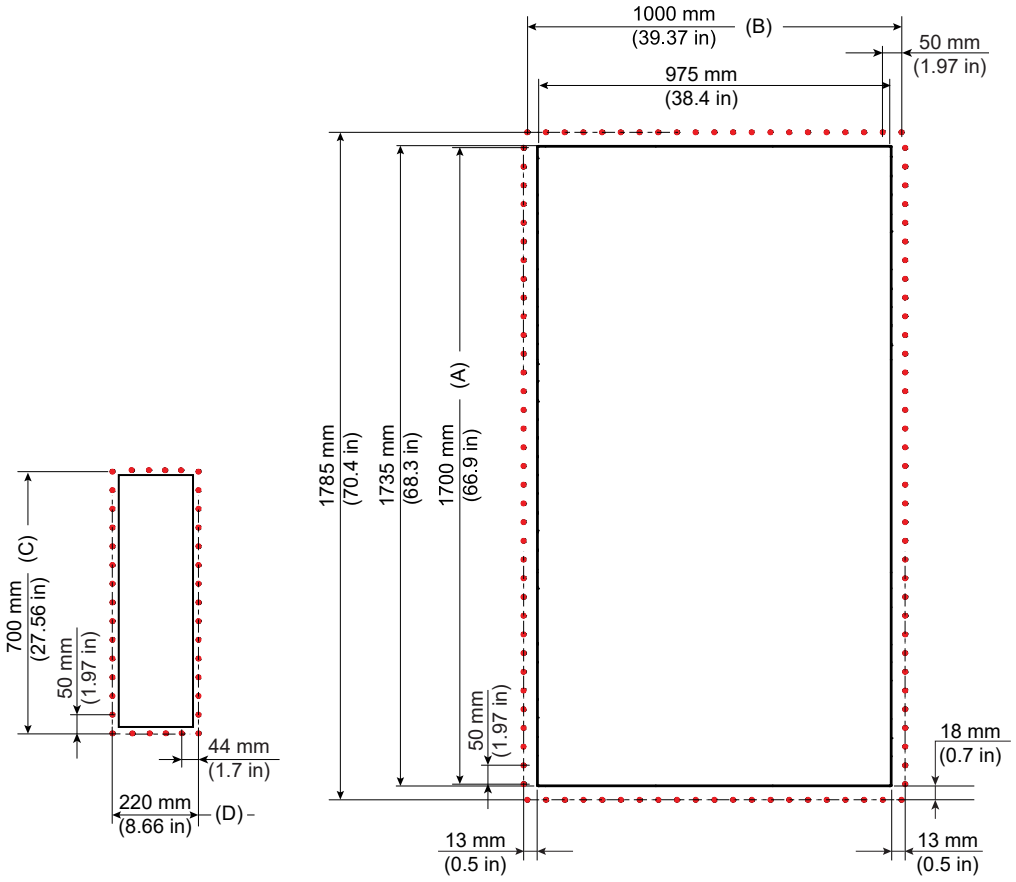
* This value is the length when the wall cutoff width is 208 mm (8.19 in.).

** This value is the length when the wall cutoff height is 680 mm (26.77 in.).

*** Cables exit the enclosure in this area.

Figure 3-8 Screw Locations for Mesh Shield and Penetration Panel (Magnet Room Side) on page 72 shows the screw locations for the Mesh Shield and Penetration Panel.

Figure 3-8 Screw Locations for Mesh Shield and Penetration Panel (Magnet Room Side)

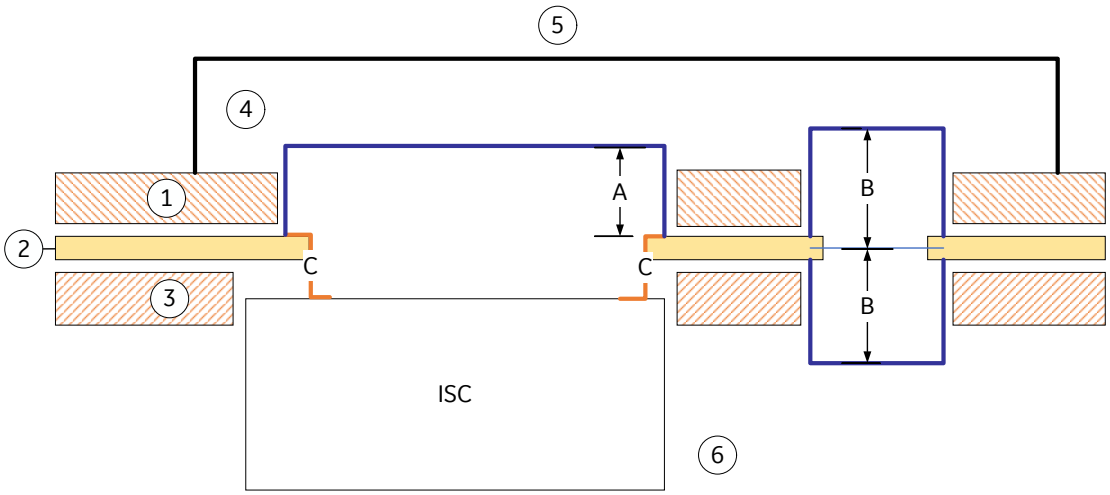


Item	Description	Item	Description
A	35 Screws, Pitch 50 mm (1.97 in.) x 34=1700 mm (66.9 in.)	C	15 Screws, Pitch 50 mm (1.97 in.) x 14=700 mm (27.56 in.)
B	21 Screws, Pitch 50 mm (1.97 in.) x 20=1000 mm (39.37 in.)	D	6 Screws, Pitch 44 mm (1.73 in.) x 5=220 mm (8.66 in.)
Total Screws	2(A+B+C+D) - 4=150 Prepare 170 screws to install the PP and Mesh Shield.		

NOTE

1. M6 screws are used to install the Mesh Shield and PP. The Mesh shield and PP will be installed from the Magnet Room side.
2. It is the RF vendor's responsibility to prepare M6 screws according to the site condition. The Mesh Shield and PP will be installed during the system installation by the mechanical installer.
3. For a wooden RF shield wall: use M6 wood screws.
4. For an RF shield wall that has holes for the screws: use M6 screws and M6 nuts.

Figure 3-9 Duct or Pit Top View



Item	Description	Item	Description
1	Magnet Room Finished Wall	A	The ISC back Cover depth is adjustable from 150 mm (5.9 in.) to 250 mm (9.8 in.).
2	RF Shield		
3	Equipment Room Finished Wall	B	The Penetration Panel Covers depth is adjustable from 300 mm (11.8 in.) to 400 mm (15.75 in.).
4	Duct or Pit Area		
5	Magnet Room	C	The Mesh Shield is adjustable from 100 mm (3.9 in.) to 110 mm (4.3 in.).
6	Equipment Room		

NOTE

When cutting the duct or pit for cable routing, make sure the ISC Cover can cover the cutoff for the cable.

It is recommended to extend the Mesh Shield in between 100 mm (3.9 in.) and 110 mm (4.3 in.). However, the Mesh Shield can be extended to 180 mm (7.1 in.) without any slack. In case there is any reason that the ISC cannot be located closely enough to the RF Shield, it is local site engineer's responsibility to extend the Mesh Shield more than 110 mm (4.3 in.). Consider floor level under the ISC when extending the Mesh Shield more than 110 mm (4.3 in.).

3.5 Finished Room Requirements

3.5.1 Ferrous Materials in the Magnet Room

1. Non-ferrous (non-metallic) materials or components should be used in the Magnet Room.
2. Ferrous components or material in the Magnet Room that could be removed for servicing, cleaning, or replacement must be secured to prevent the ferrous material from becoming a projectile (ferrous components or material must also be identified as ferrous to prevent untrained personnel from working on the ferrous material while the magnet is energized).

3.5.2 Walls

Refer to *Acoustic Room Details*, 5850262-1EN. Hard, bare wall surfaces may create a harsh Magnet Room acoustic environment due to reflection of sound waves. Finished walls with acoustic properties can reduce reflected noise.

1. GE HealthCare recommends finished walls to protect the RF shielding.
2. Walls and any millwork, cabinets, storage areas, acoustic coverings, and so on, must remain outside the minimum service area.
3. A metallic electrical conduit inside walls and ceilings may be used. Conduit for receptacles must be metallic.

3.5.3 Magnet Preinstallation Markings

For correct cryogen venting, the magnet vent adaptor must align correctly with the ceiling vent when the magnet is installed.

1. The magnet isocenter position must be clearly marked, and the marking must be identifiable throughout construction.

   NOTE
   If there is no ceiling grid in the room, we recommend to also mark the magnet isocenter location on the ceiling. This can serve as a reference for positioning a new vent pipe, or can be used to reproduce the floor markings if they become lost during construction.

   Refer to *Magnet Room Venting Requirements*, 5850263-1EN for the location of the magnet vent.

2. If no ceiling vent pipe exists prior to construction, the location of the magnet isocenter and magnet z-axis orientation must be marked on the Magnet Room floor as shown below.

Figure 3-10 Marking Magnet Isocenter (in a Room Without a Vent Pipe)

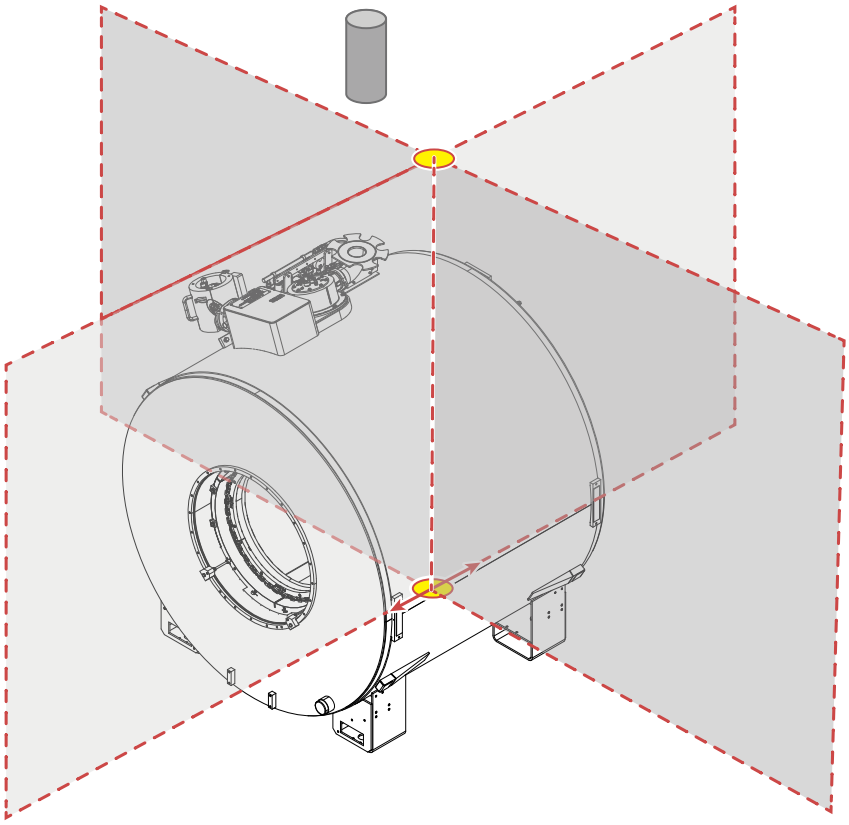
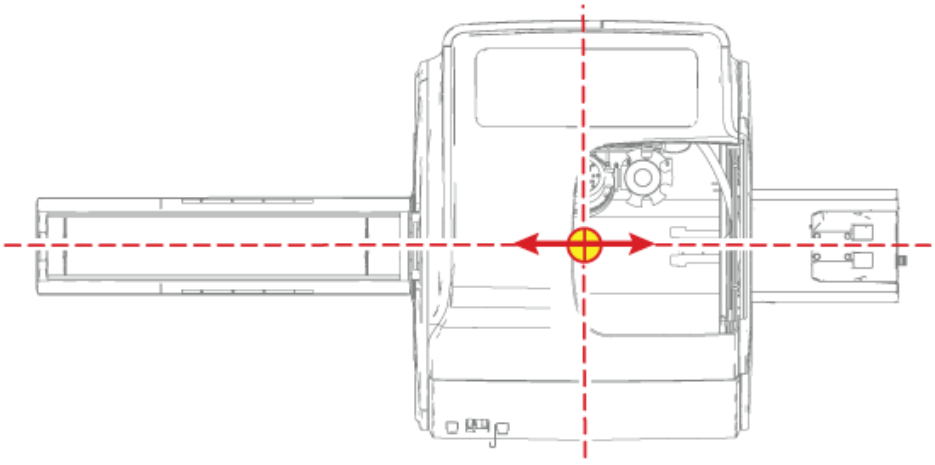


Figure 3-11 Marking the Magnet Isocenter and the Z-Axis Orientation on the Floor

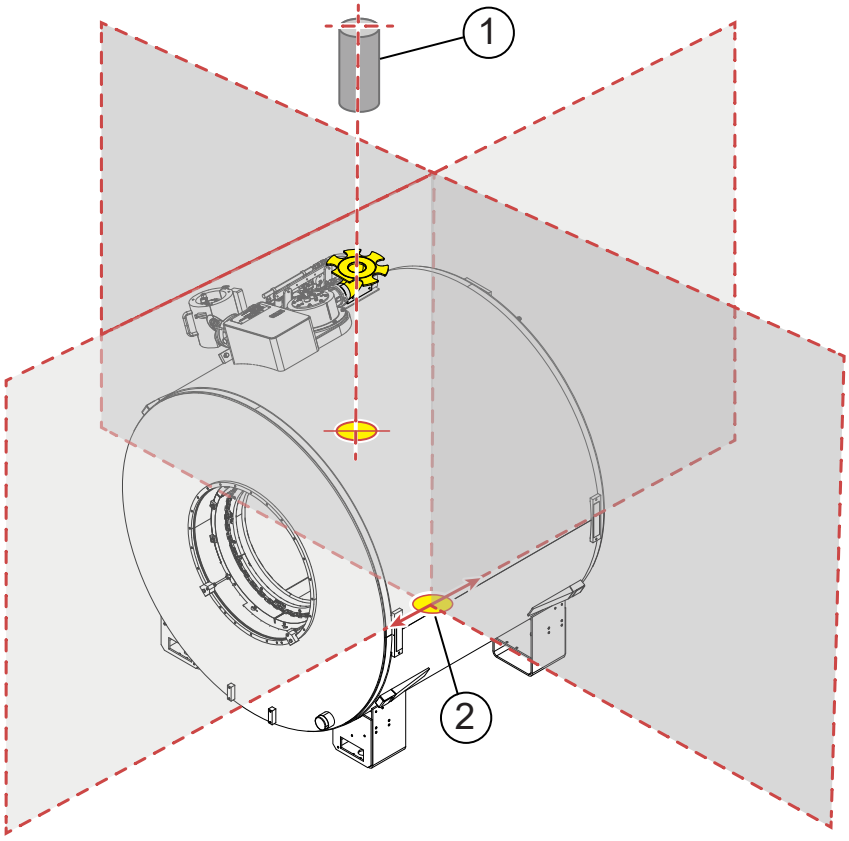


3. If a ceiling vent pipe already exists at the start of construction, the magnet isocenter marking must be correctly aligned relative to the position of the vent pipe. Refer to *Magnet Room Venting Requirements*, 5850263-1EN for the location of the magnet vent.

NOTE
We recommend:

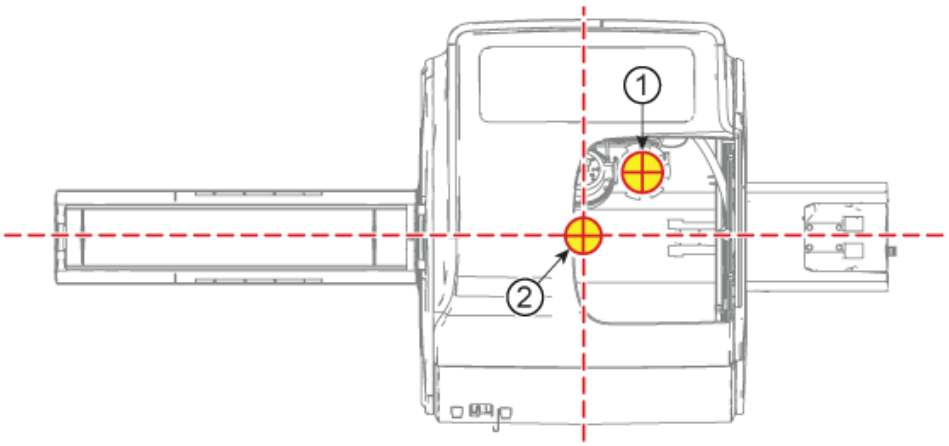
- Marking the center of the vent pipe.
- Using a cross line laser or other accurate method to transcribe it to the floor directly below.
- Marking the magnet isocenter relative to the vent pipe marking on the floor. The positioning template (5810898 or 5810898-2 for PM Series Magnet and 5810898-7 and -8 for R Series Magnet) can be used as a marking aid.

Figure 3-12 Marking the Center of the Vent Pipe



Item	Description
1	Vent center
2	Magnet isocenter

Figure 3-13 Marking the Vent Pipe and Magnet Isocenter on the Floor



Item	Description
1	Vent center
2	Magnet isocenter

3.5.4 Doors, Magnet Access Openings, and Patient Viewing Windows

1. The finished opening of the Magnet Room main door must be at least 1092 mm (43 in.) wide to allow for helium dewars and patient tables.
2. Threshold height must not exceed 15 mm (0.6 in.) on both sides of the door with a maximum 10-degree threshold inclination.
3. IEC requires the patient, while in the bore, be in full view of the operator.

NOTE

- GE HealthCare recommends using a window, although other means (for example, camera and video display) may be used as long as all IEC requirements are met.
- The recommended dimensions for the patient viewing windows are 1219 mm wide x 762 mm high (48 in. wide x 30 in. high).
- The recommended distance from the bottom edge of the patient viewing window to the finished floor is 1067 mm (42 in.).

4. The magnet delivery requires an opening into the room to allow access for the magnet delivery, rigging, and personnel access.

3.5.5 Finished Ceiling

1. The customer is responsible for the finished ceiling.
2. The finished ceiling grid must be non-ferrous.
3. Ceiling preparation should be completed prior to magnet delivery.

3.5.6 Magnet Room Floors

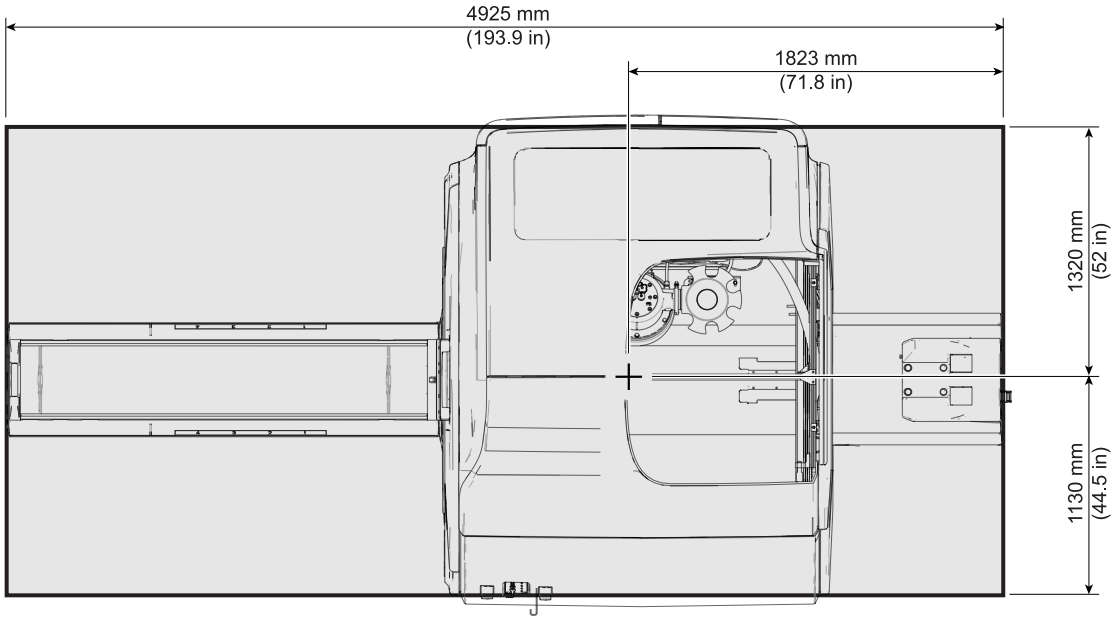
1. The finished floor must support the weight of all components throughout operation and service life. This includes the magnet, patient table, and gradient coil replacement cart.

NOTE

For gradient coil replacement, field engineers remove the patient table from the Magnet Room before they move the gradient coil replacement cart into the Magnet Room.

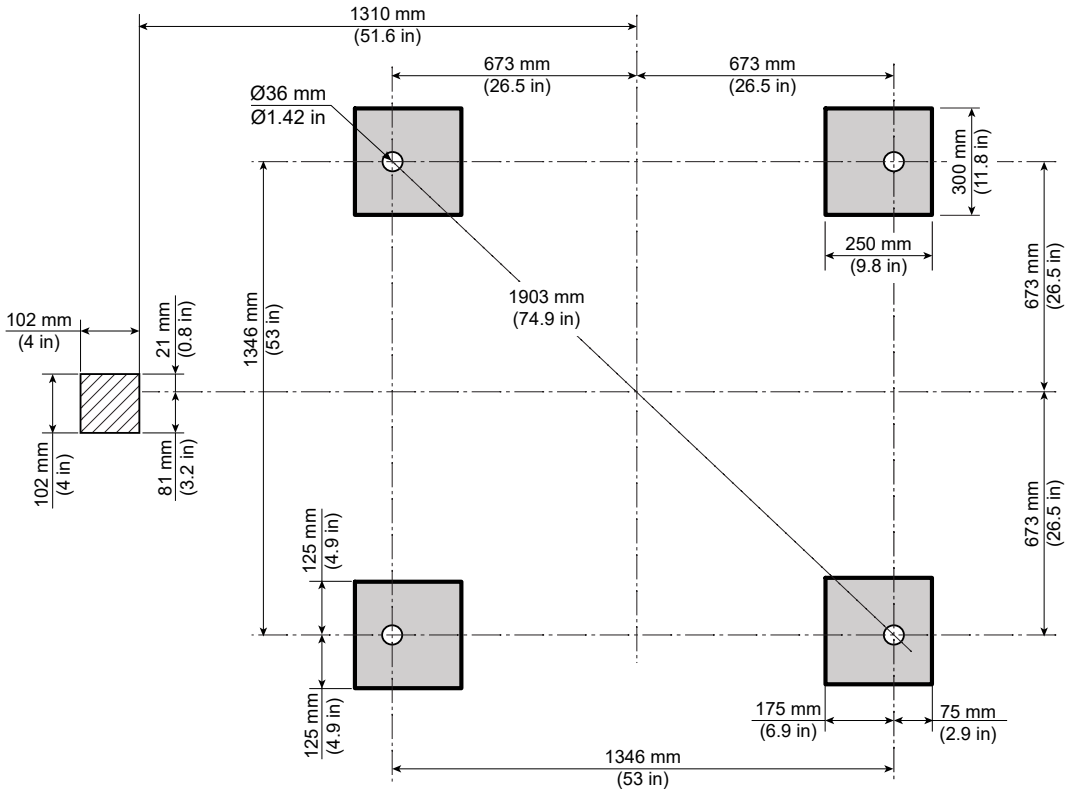
2. The finished floor must be water resistant to protect the subfloor and shielding from water damage.
3. The customer is responsible for providing flooring to prevent ESD (Electrostatic Discharge) buildup to 8 kV for protection of the sensitive MR equipment.
4. Magnet, Enclosure, and Patient Table areas must be flat and level within 3 mm (0.125 in.), with the magnet in place, within the shaded area shown in Figure 3-14 Magnet Room Floor Levelness Area on page 79.

Figure 3-14 Magnet Room Floor Levelness Area



5. **For R series magnet only:** The VibroAccoustic Dampening kit for both seismic and non-seismic mounting is M50002LP. See below for dimensions that aid in the calculation for floor loading. See Figure 3-15 For R series magnet only: Magnet Mounting Detail for M50002LP —Patient End is on the Left Side on page 80 for details.
   - Weight: 8 kg (17 lb.) each
   - Size: 300 x 250 mm (11.81 x 9.84 in.) each
   - Anchor holes (x4) 36 mm (1.42 in.).
   - A 132 mm x 139 mm (5.17 in. x 5.5 in.) rebar-free area is necessary under the table dock/table frame anchor.

Figure 3-15 For R series magnet only: Magnet Mounting Detail for M50002LP —Patient End is on the Left Side

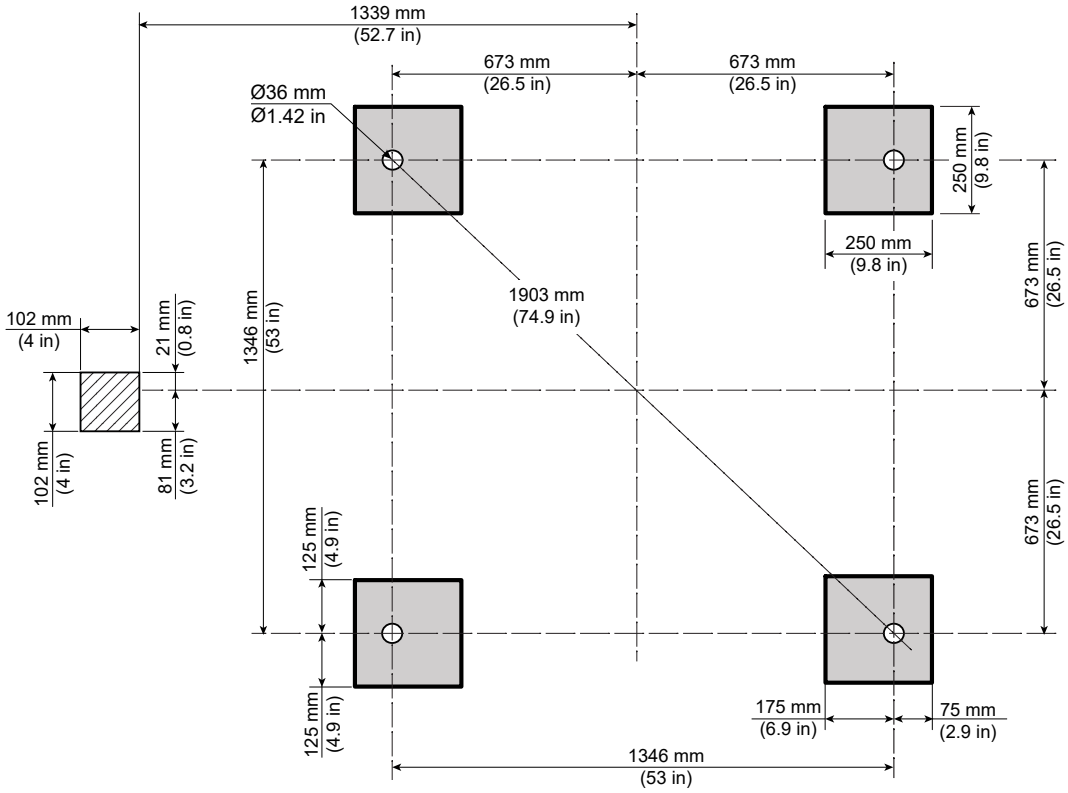


6. **For PM series magnet only:** The VibroAccoustic Dampening kit for both seismic and non-seismic mounting is included with the magnet shipment. See Figure 3-16 For PM series magnet only: Magnet Mounting Detail— Patient End is on the Left Side on page 81 for details.

   - For seismic installations, a mounting hardware kit for the magnet feet (M6001AH) is available from GE HealthCare.
   - Seismic anchors shall have a 76.2 mm (3 in) rebar-free area around the anchor and shall be installed with the assistance of the RF shield vendor. Seismic anchor studs must be 1 1/4" in diameter, and 5.75" +/- 0.25" in length above the finished floor.
   - A 102 mm x 102 mm (4 in. x 4 in.) rebar-free area is necessary under the table frame anchor, in the position shown in the illustration below.

IMPORTANT
The table frame anchor hole is drilled only after magnet installation.

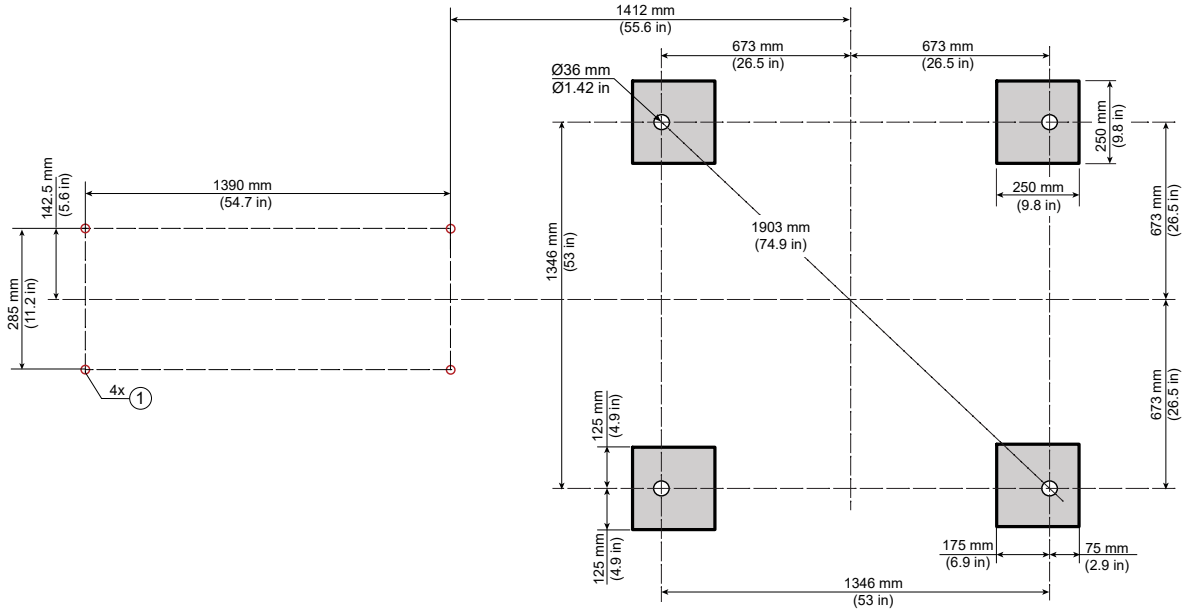
Figure 3-16 For PM series magnet only: Magnet Mounting Detail— Patient End is on the Left Side



7. **(For Patient Table Seismic Kit)** : See Figure 3-17 Patient Table Seismic kit mounting details on page 82.

   - For seismic installations, seismic kit is available from GE HealthCare, and seismic anchors should be provided by customer/contractor.
   - Seismic anchors must be isolated from rebar.

Figure 3-17 Patient Table Seismic kit mounting details

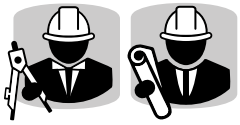


Item	Description
1	4 Seismic mounting holes, ⌀17.2mm (0.68 in.)

IMPORTANT
The table seismic anchor holes are drilled only after magnet and patient table installation.

8. RF shield seams, joints, or overlaps must not be located under the VibroAcoustic mats.

3.5.7 Storage Cabinets



NOTE
GE HealthCare no longer provides a storage solution for system phantoms.

1. The customer shall provide storage for phantoms in the magnet room (for example, a cart, shelving unit or cabinet). Storage needs to be large enough to accommodate system phantoms listed in Table 1-1 of *Customer Site Storage Requirements*, 5182674 (available in the Customer Documentation Portal).
2. The storage solution can not interfere with the magnet room minimum service area.

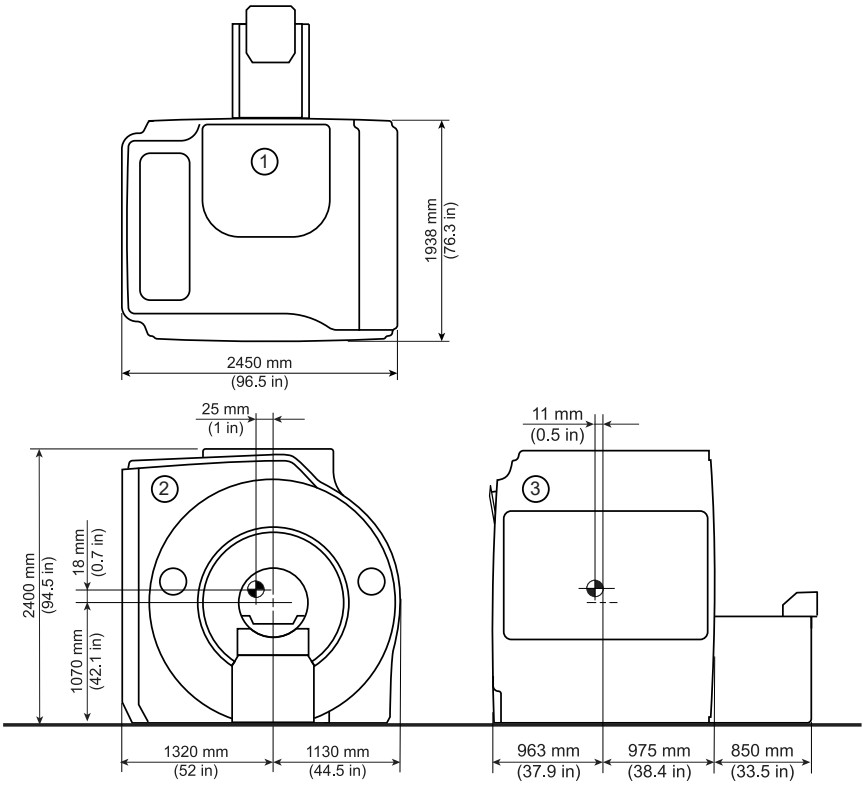
3.6 Magnet Room Equipment Specifications

(Applies to all subsections within this section)

3.6.1 Magnet (MAG) Assembly Specifications

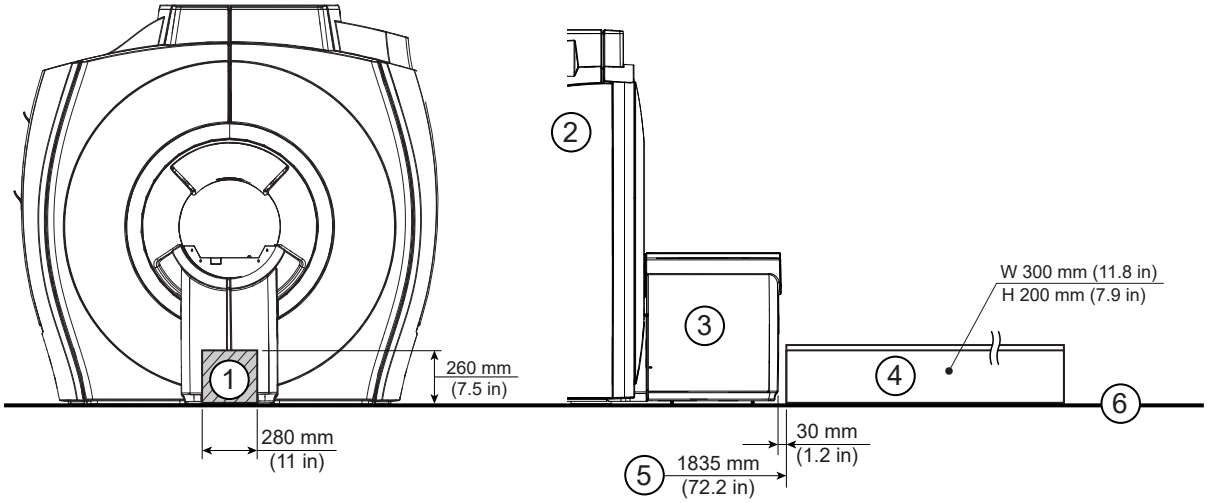
1. PM series magnet weight, with cryogens at maximum capacity: 4784 kg (10547 lb.)
2. R series magnet weight, with cryogens at maximum capacity: 5320 kg (11700 lb.)
3. Rear pedestal weight: 73 kg (161 lb.)

Figure 3-18 Magnet (MAG) Dimensions



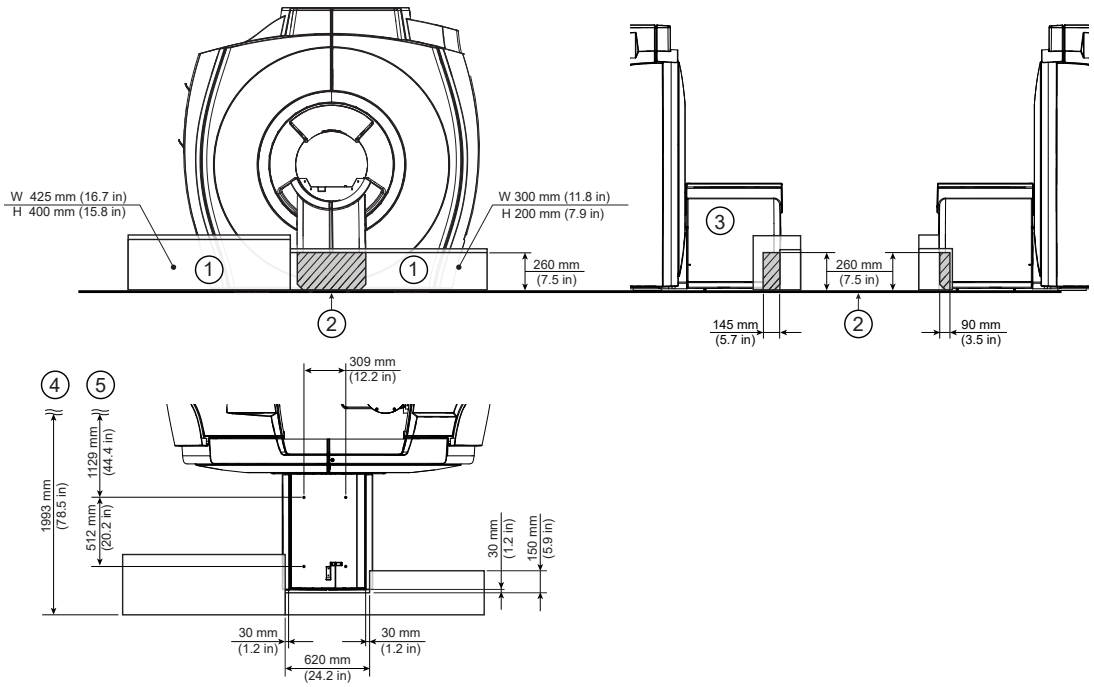
Item	Description	Item	Description
1	Top view	2	Front view
3	Side view	-	-

Figure 3-19 Recommended duct space behind rear pedestal



Item	Description	Item	Description
1	Cover for rear cable access	4	Floor duct
2	Magnet	5	From magnet isocenter
3	Rear pedestal	6	Finished floor

Figure 3-20 Limitation of Duct size for Minimum Room layout



Item	Description	Item	Description
1	Floor duct	4	From magnet isocenter to floor duct
2	Finished floor	5	From magnet isocenter
3	Rear pedestal	-	-

NOTE

Add edge guards or tape to the cut edge of rear pedestal covers.

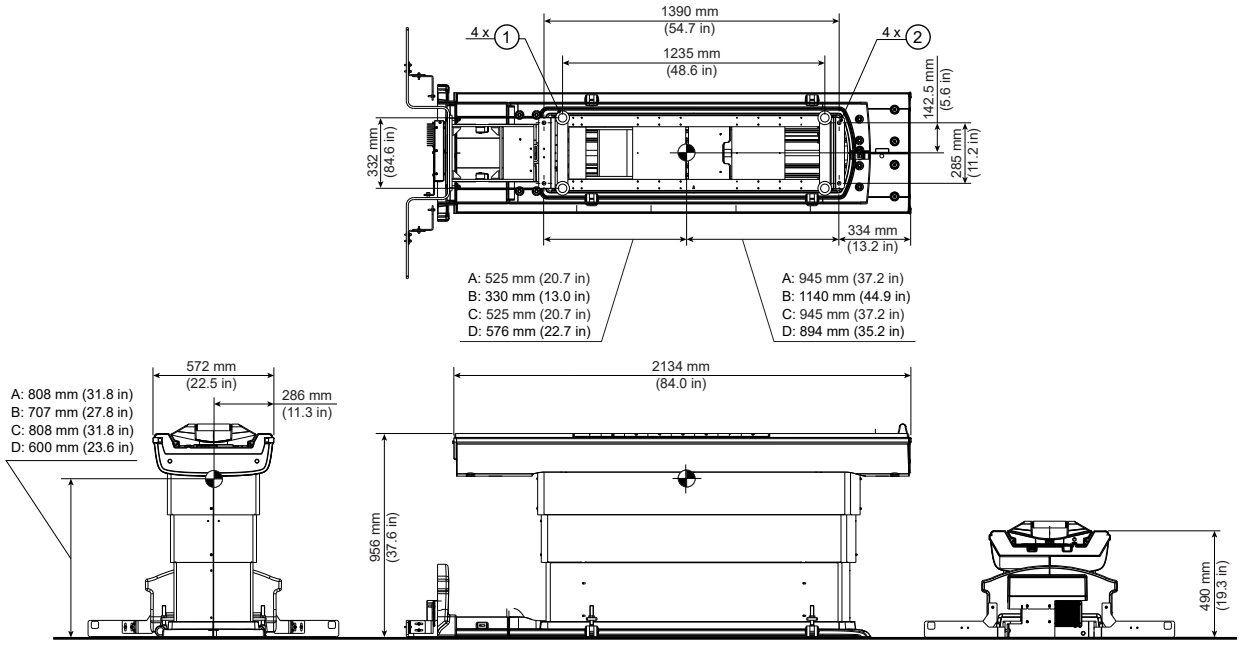
30 mm (1.18 in.) minimum clearance is required between rear pedestal and surface of duct.

Shaded area of rear pedestal shows the cutout area.

3.6.2 Patient Table (PT) Specifications

1. Low Height Fixed Table weight, empty: 136 kg (300 lb.)
2. Low Height Fixed Table weight, including maximum patient weight of 200 kg (440 lb.) and accessories: 366 kg (807 lb.)

Figure 3-21 Low Height Fixed Patient Table (PT)



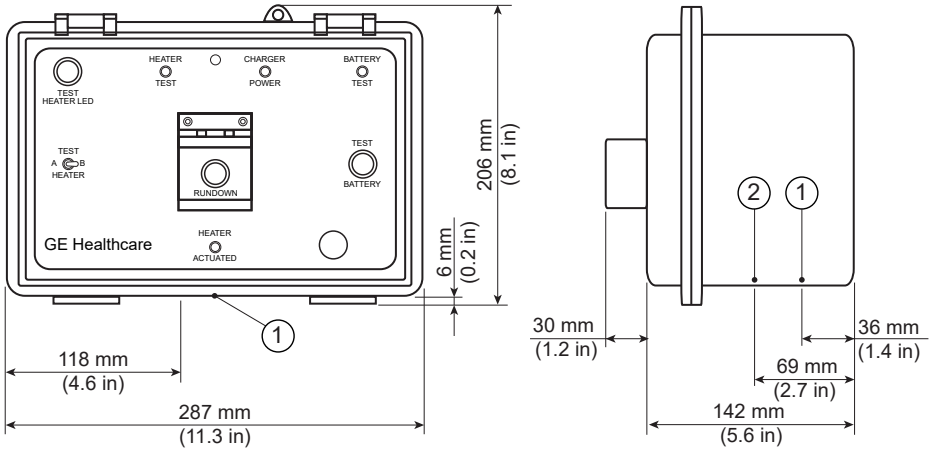
Item	Description	Item	Description
A	336 kg (741 lb.): Patient is on the table being prepared for scanning, not in the bore. Table is at the highest position.	C	336 kg (741 lb.): Patient is on the table and cradle is 50 mm (2 in.) into the bore. Table is at the highest position.
B	196 kg (432 lbs.): Patient is moved 1470 mm (58 in.) into the bore and scanning. Table is at the highest position.	D	136 kg (300 lbs.): Patient is not on the table. Table is at the highest position.
1	Leveling Pad	2	4 Seismic mounting holes, ⌀17.2mm (0.68 in.)

3.6.3 Magnet Rundown Unit (MRU) Specifications and Requirements

1. Location: The bottom edge of the MRU must be mounted 1524 ± 25 mm (60 ± 1 in.) above the Magnet Room floor near the front of the magnet enclosure.
2. Weight: 3.2 kg (7 lb.)

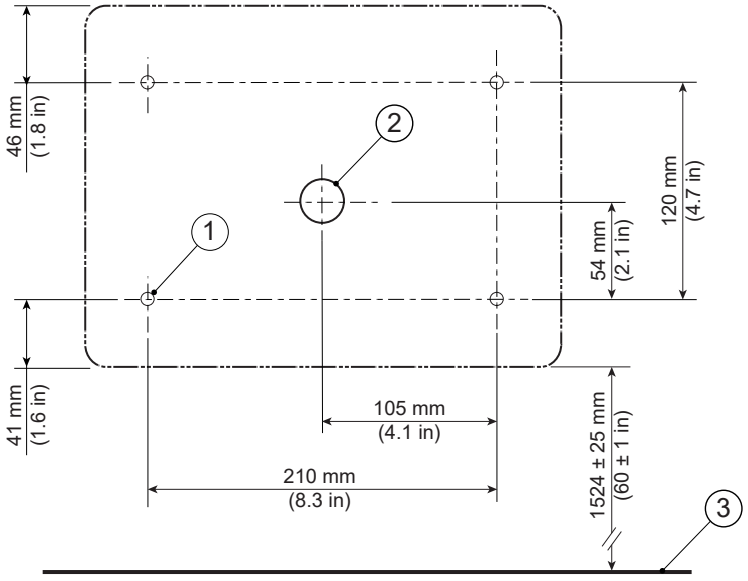
3. Magnetic Field Limit: 20 mT (200 G)
4. The MRU is installed by the facility contractor.

Figure 3-22 Magnet Rundown Unit (MRU)



Item	Description
1	Cable access
2	Power access

Figure 3-23 MRU Mounting Pattern



Item	Description	Item	Description
1	7 mm (0.275 in.) diameter mounting hole	3	Finished floor
2	26 mm (1.025 in.) diameter cable access	-	-

3.7 Magnet Room Lighting Requirements

1. All lighting fixtures and associated components must meet all RF shielded room and RF grounding requirements (for example, track lighting is not recommended due to possible RF noise).
2. All removable lighting fixtures and associated components must be non-magnetic.
3. All lighting must use direct current (the DC must have less than 5% ripple).
4. At least 300 lux must be provided at the front of the magnet for patient access and above the magnet for servicing.
5. Fluorescent lighting must not be used in the Magnet Room.
6. Lighting must be adjusted using a discrete switch or a variable DC lighting controller.
7. SCR dimmers or rheostats must not be used.
8. DC LED lighting may be used if the DC power converter and RF sources are all located outside the Magnet Room RF Shield.

   NOTE
   LED lighting could cause image quality issues due to RF interference. Make sure a MR-compatible LED lighting solution is chosen.
9. Battery chargers (for example, used for emergency lighting) must be located outside the Magnet Room.
10. LED Lighting or short filament length incandescent bulbs are recommended.
11. Linear lamps are not recommended due to the high burnout rate.

4 Equipment Room

4.1 Equipment Room Overview

(Applies to all sections within this chapter)

1. The ICC and ISC must be located on the same floor.

NOTE
The ICC contains the cryocooler compressor.

The following illustration shows minimum equipment room service clearances. Refer to MR Suite Minimum Room Size Requirements on page 17 for a list of considerations not included in the minimum area dimensions.

NOTE
Colored areas indicate service/installation areas. These areas can overlap as necessary as shown below. See individual component descriptions and room requirements for service area details. Optional equipment is not shown; additional space may be required for options.

NOTE
Refer to Table 2-19 MR System Component Replacement Shipping Specifications on page 59 for the dimensions of the replacement parts. The parts must be able to be positioned in front of the noted cabinet for replacement procedures after the system has been installed.

Figure 4-1 Typical Minimum Equipment Room with Service Clearances (Type B)

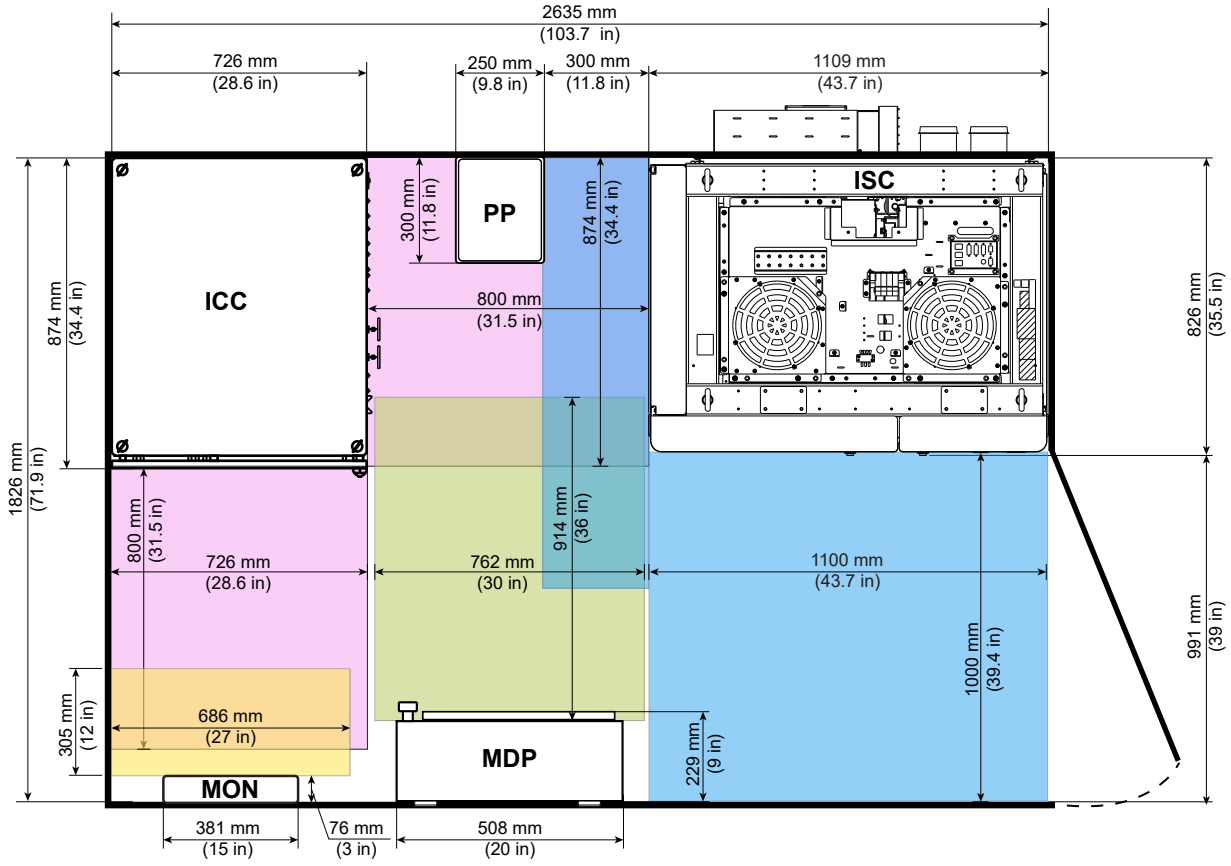
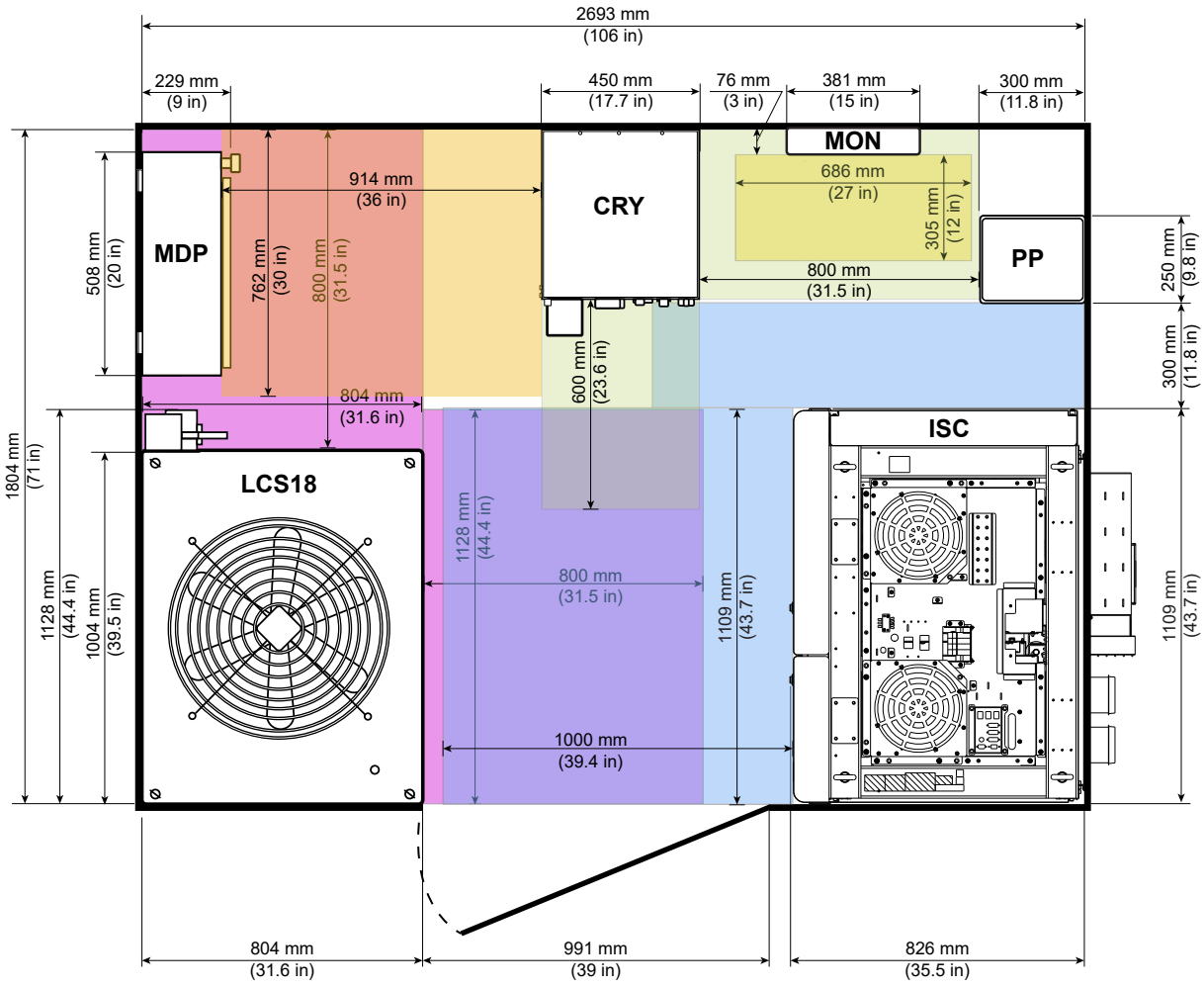


Figure 4-2 Typical Minimum Equipment Room with Service Clearances (Type D)



4.2 Main Disconnect Panel (MDP) Requirements and Specifications

4.2.1 Requirements

1. It is recommended to install the following items to support a power monitor:
   1.1. A T100 network connection with RJ45 connector near the MDP
   1.2. An electrical outlet
2. The cable must be Cat 5 or better.
3. The network connection must not be routed through the Ethernet switch in the Global Operator Cabinet (GOC).

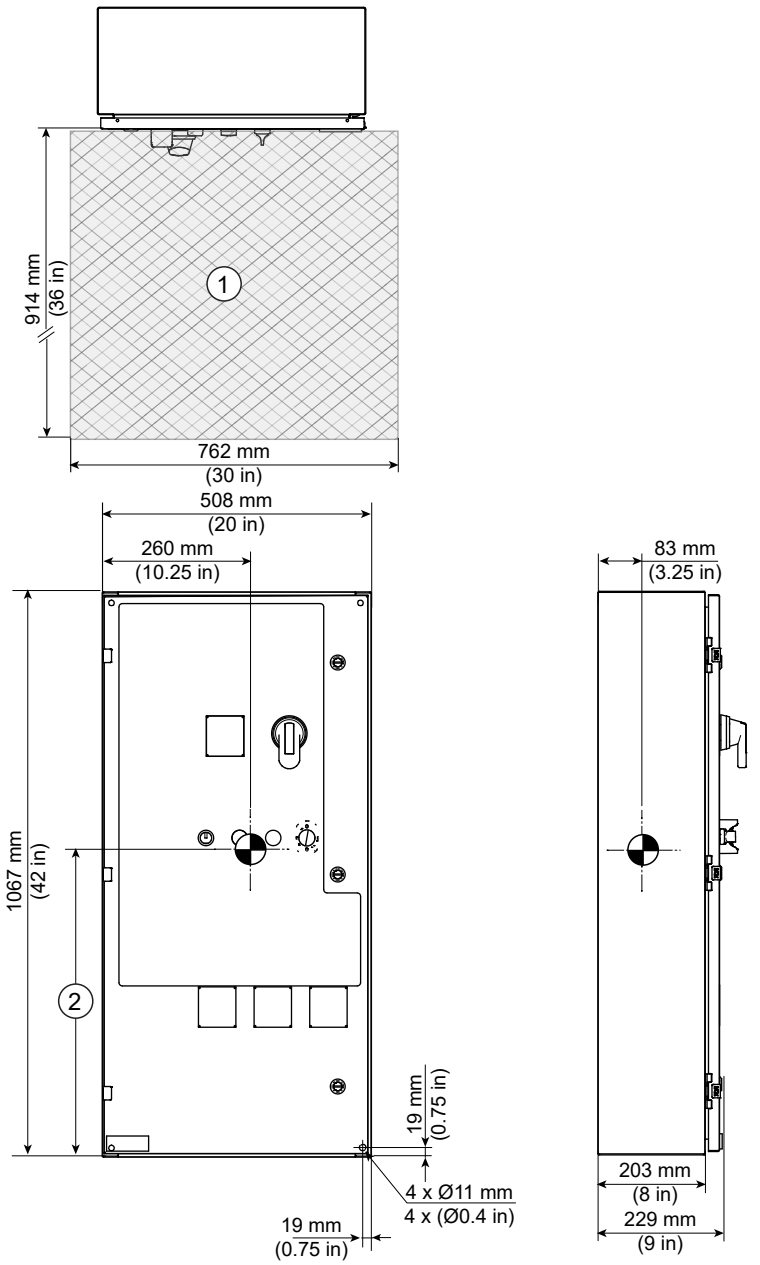
4.2.2 Specifications

The Main Disconnect Panel (MDP) is provided with the MR System. Only exempt countries can supply their own MDP (see 2.10.3 Customer-supplied Main Disconnect Panel (MDP) Requirements (exempt countries only*) on page 53).

M50022MB and M50022MC

1. **M50022MB**, Weight: 61 kg (134 lb).
2. **M50022MC**, Weight: 60 kg (132 lb).
3. Magnetic Field Limit: 5 mT (50 G)

Figure 4-3 GE HealthCare supplied Main Disconnect Panel (MDP) M50022MB and M50022MC



Item	Description
1	Service Clearance
2	Center of gravity dimension for M50022MB is 552 mm (21.75 in)
	Center of gravity dimension for M50022MC is 546 mm (21.5 in)

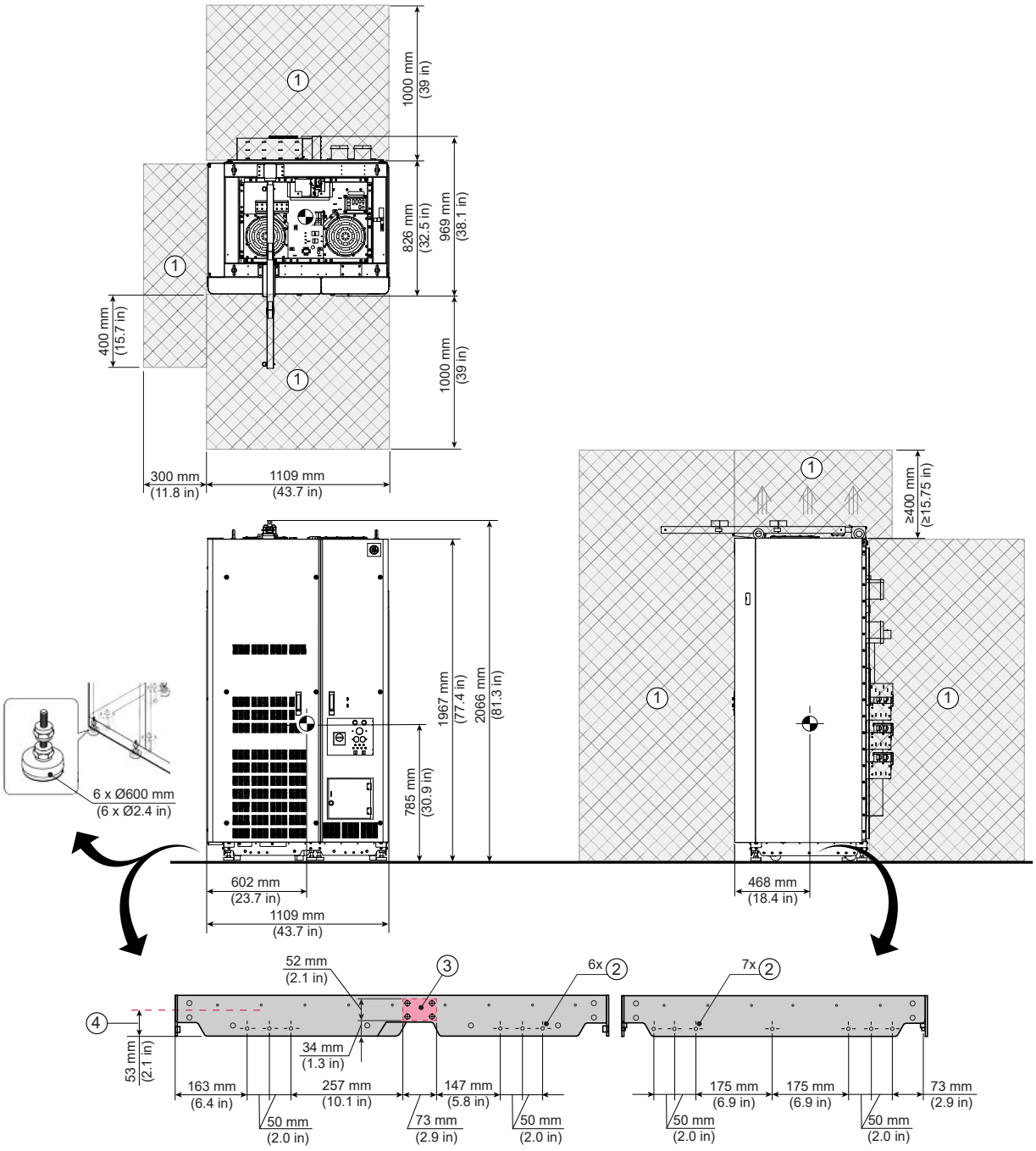
4.3 Integrated System Cabinet (ISC)

Weight: Approx 840kg (1852 lb).

Magnetic Field Limit: 5 mT (50 G) (Penetration Panel (Back Panel) side)

Contact Area: 2461.76 mm^2 (3.82 in^2) for each support. There are 6 supports in total.

Figure 4-4 Integrated System Cabinet



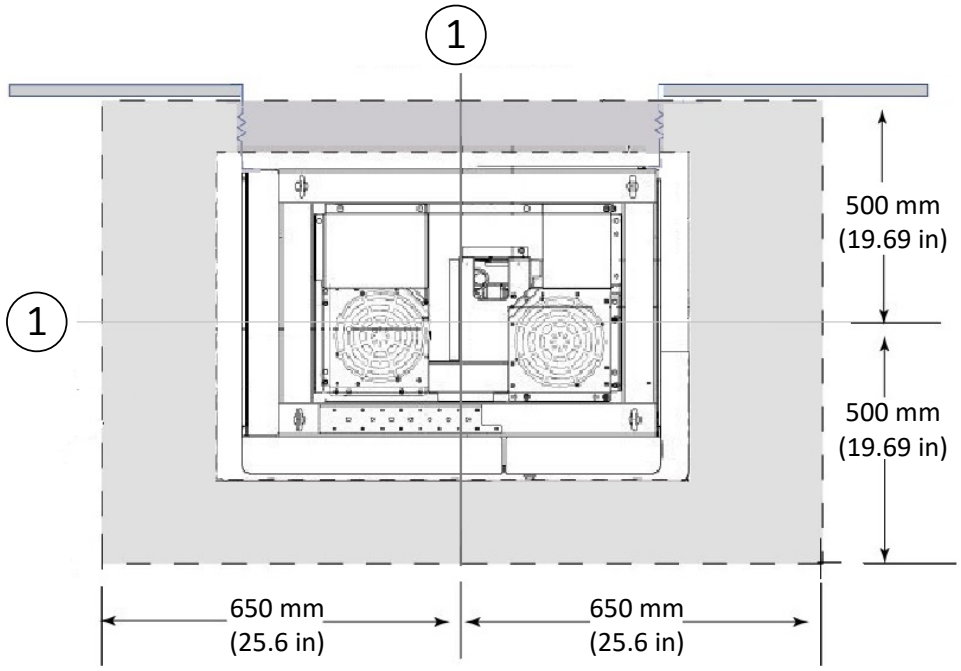
Item	Description	Item	Description
1	Service clearance	2	Seismic anchor mounting holes (All M8-1.25)
3	Customer-supplied seismic mounting bracket shall not interfere with the highlighted area.	4	Maximum height of Customer-supplied seismic mounting bracket

NOTE

Make sure that the seismic brackets and anchors do not conflict with ISC covers and water hose routing.

Area must be level according to the specification in Figure 4-5 Area to be leveled on page 95.

Figure 4-5 Area to be leveled



Item	Description
1	Base Center

NOTE
Shaded area must be leveled.

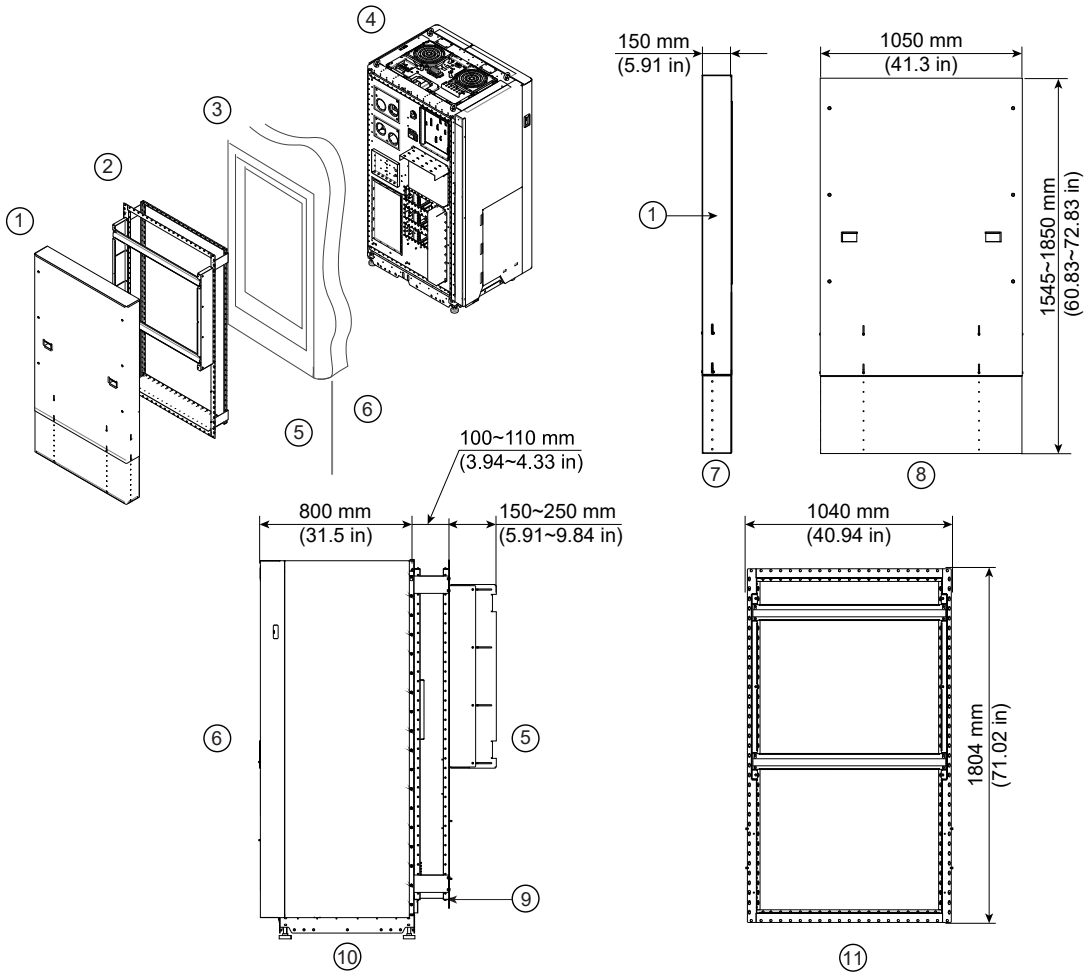
Specification of Floor

1. Floor slope: < ± 0.5 deg
2. Floor surface: < ± 5 mm
3. Non-compressible flooring material only. For example, no carpet allowed.

4.4 Mesh Shield and Integrated System Cabinet (ISC) Cover

Figure 4-6 Mesh Shield and ISC Cover on page 96 shows the relationship and dimensions of ISC, RF shield wall, Mesh Shield and Cover.

Figure 4-6 Mesh Shield and ISC Cover

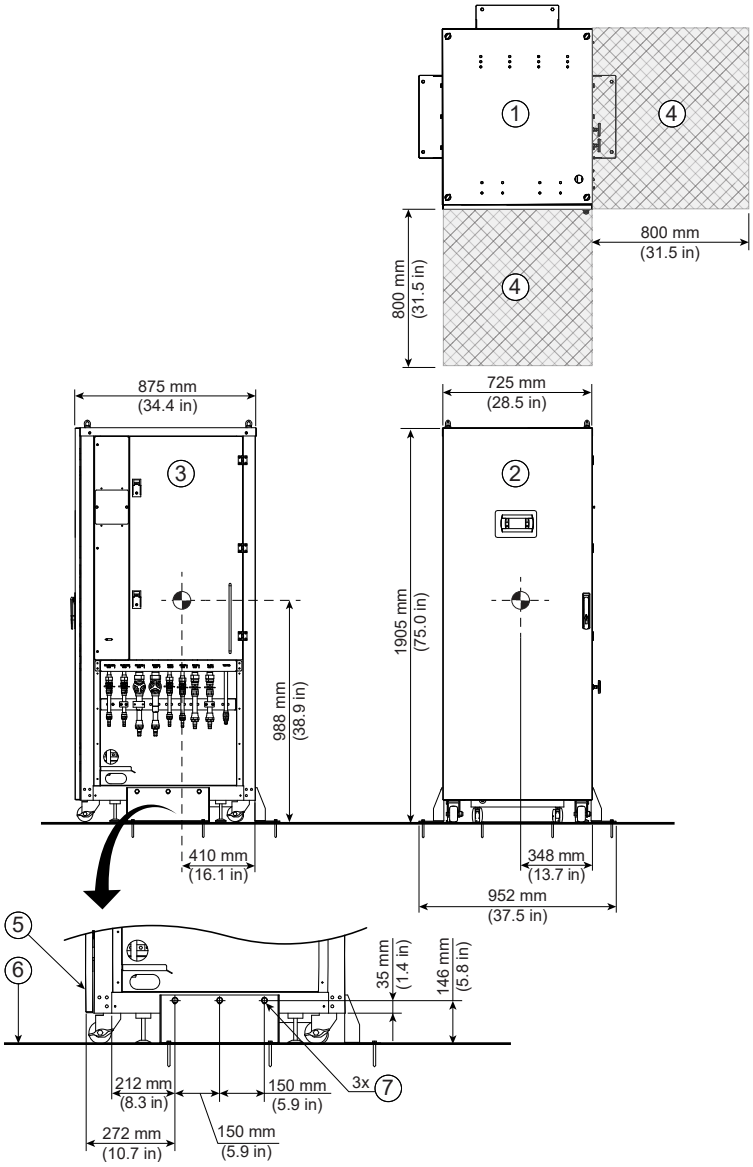


Item	Description	Item	Description
1	Cover	2	Mesh Shield ISC
3	Wall Cut Out	4	ISC
5	Magnet Room	6	Equipment Room
7	Side View of Cover	8	Front View of Cover
9	Surface attached to RF shield layer	10	Side View of ISC
11	Front View of Mesh Shield	-	-

4.5 Integrated Cooling Cabinet (ICC) Specifications

1. Weight of ICC without F-50SH compressor: 292 kg (644 lb.)
2. F-50SH Cryocooler Compressor weight: Approx 125 kg (276 lb.)
3. Magnetic Field Limit: 5 mT (50 G) (Penetration Panel side)

Figure 4-7 Integrated Cooling Cabinet (ICC)

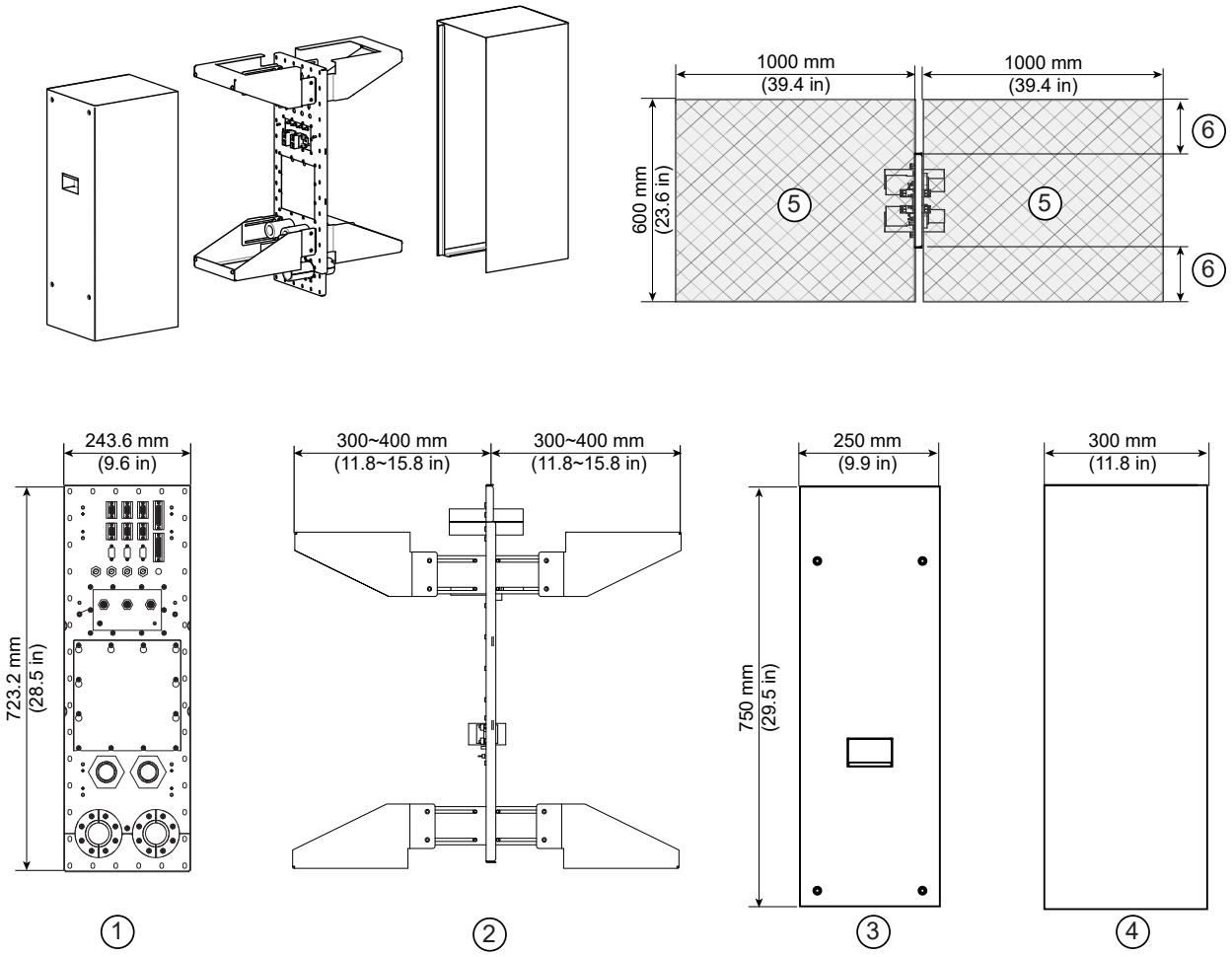


Item	Description	Item	Description
1	Top View	2	Front View
3	Side View	4	Service/Air Flow Clearance
5	Front Cover	6	Finished Floor
7	(6) M8 Seismic Anchor Mounting Holes	-	-

4.6 Penetration Panel

Magnetic Field Limit: 20 mT (200 gauss)

Figure 4-8 Penetration Panel (PP) and Cover

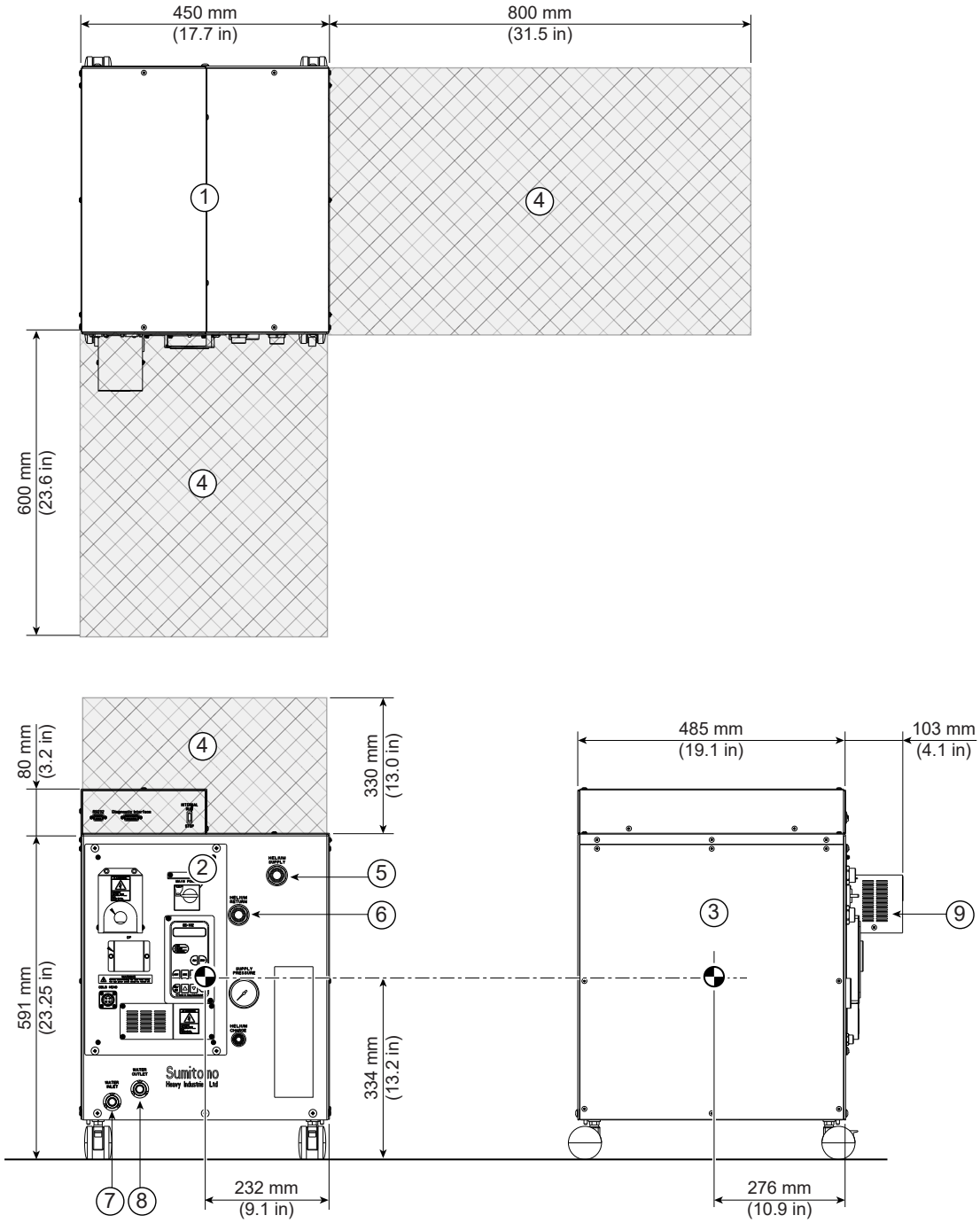


Item	Description	Item	Description
1	Penetration Panel Front View	2	Penetration Panel and Frame Side View
3	Penetration Panel Cover Front View	4	Penetration Panel Cover Side View
5	Service Clearance	6	Minimum Service Clearance at each side is 60 mm (2.4 in.). The Penetration Panel (PP) does not need to be centered in the Service Clearance.

4.7 Cryocooler Compressor (CRY) Specifications

1. F-50SH Cryocooler Compressor Weight: Approx 120 kg (264 lb.)
2. Magnetic Field Limit: 10 mT (100 G)

Figure 4-9 Cryocooler Compressor F-50SH (Water Cooled)



Item	Description	Item	Description
1	Top view	6	Helium return
2	Front view	7	Water supply
3	Side view	8	Water return
4	Service clearance	9	Input power terminal
5	Helium supply	-	-

4.8 18kW Water Chiller

Specifications

1. Weight:
   - Dry weight (without coolant): 300 kg (661 lb.)
   - Wet weight (with coolant): 350 kg (772 lb.)
2. Magnetic Field Limit: 5 mT (50 G)
3. If the equipment room ceiling height is between **2355 mm (92.7 in.) and 2500 mm (98.4 in.)**, a duct should be provided by a local vendor. Refer to Figure 4-12 Duct (Option 1) on page 102 and Figure 4-13 Duct (Option 2) on page 103 for ducting options.
4. The 18kW Chiller, ISC and Compressor must be located on the same level.

Figure 4-10 18kW Water Chiller (LCS18)

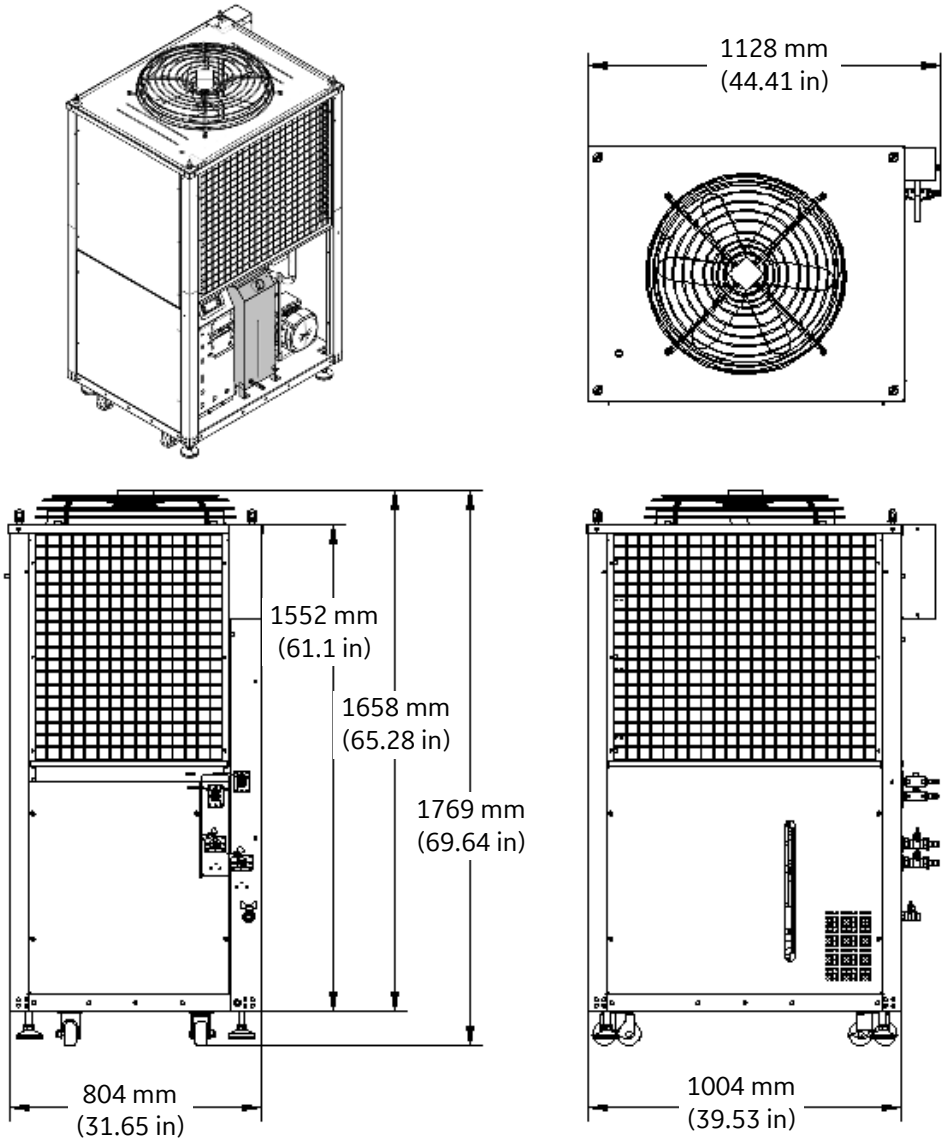
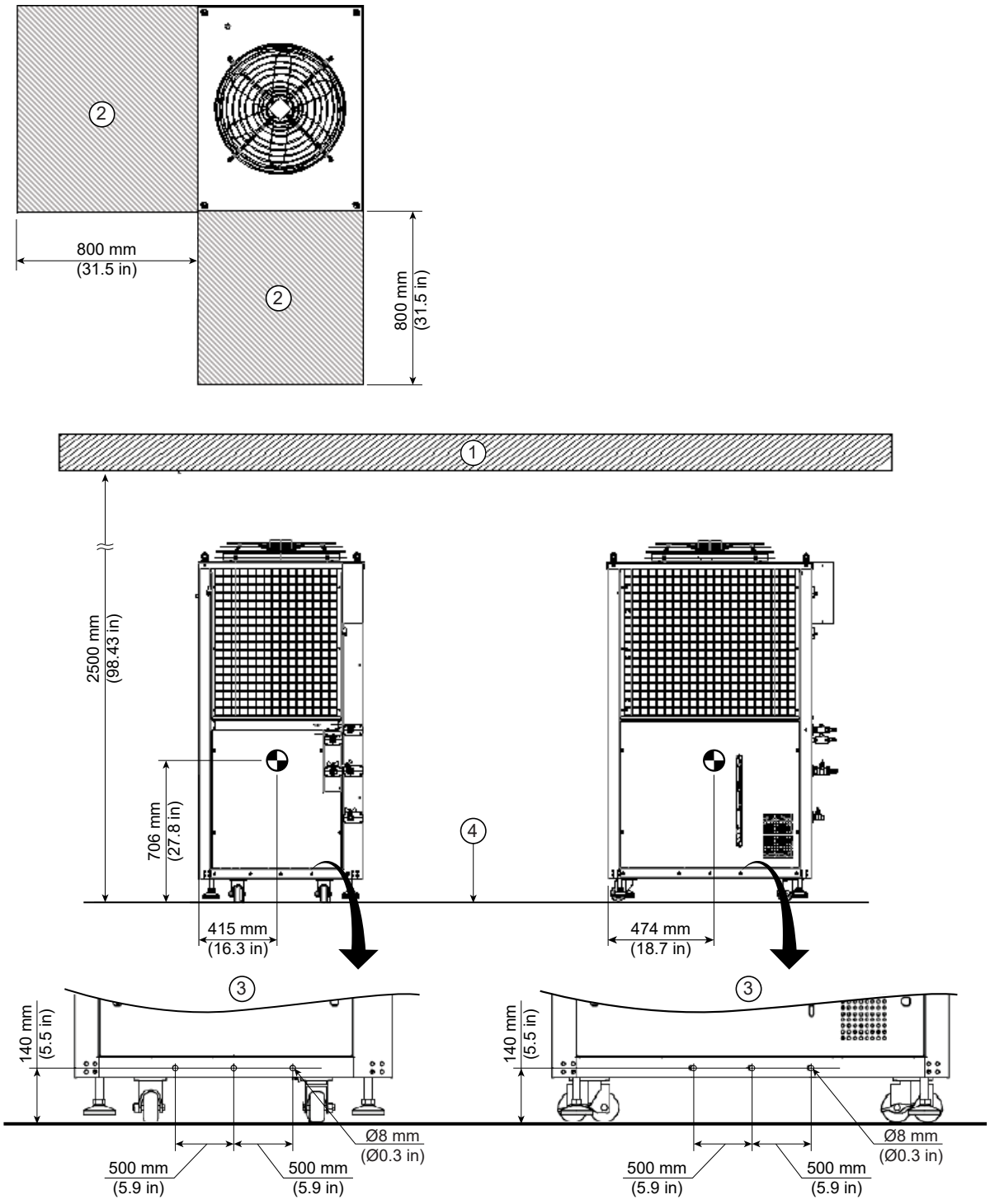


Figure 4-11 Minimum Service and Heat Dissipation Space



Item	Description	Item	Description
1	Ceiling	3	Seismic anchor mounting location
2	Service area and air intake area	4	Finished floor

Figure 4-12 Duct (Option 1)

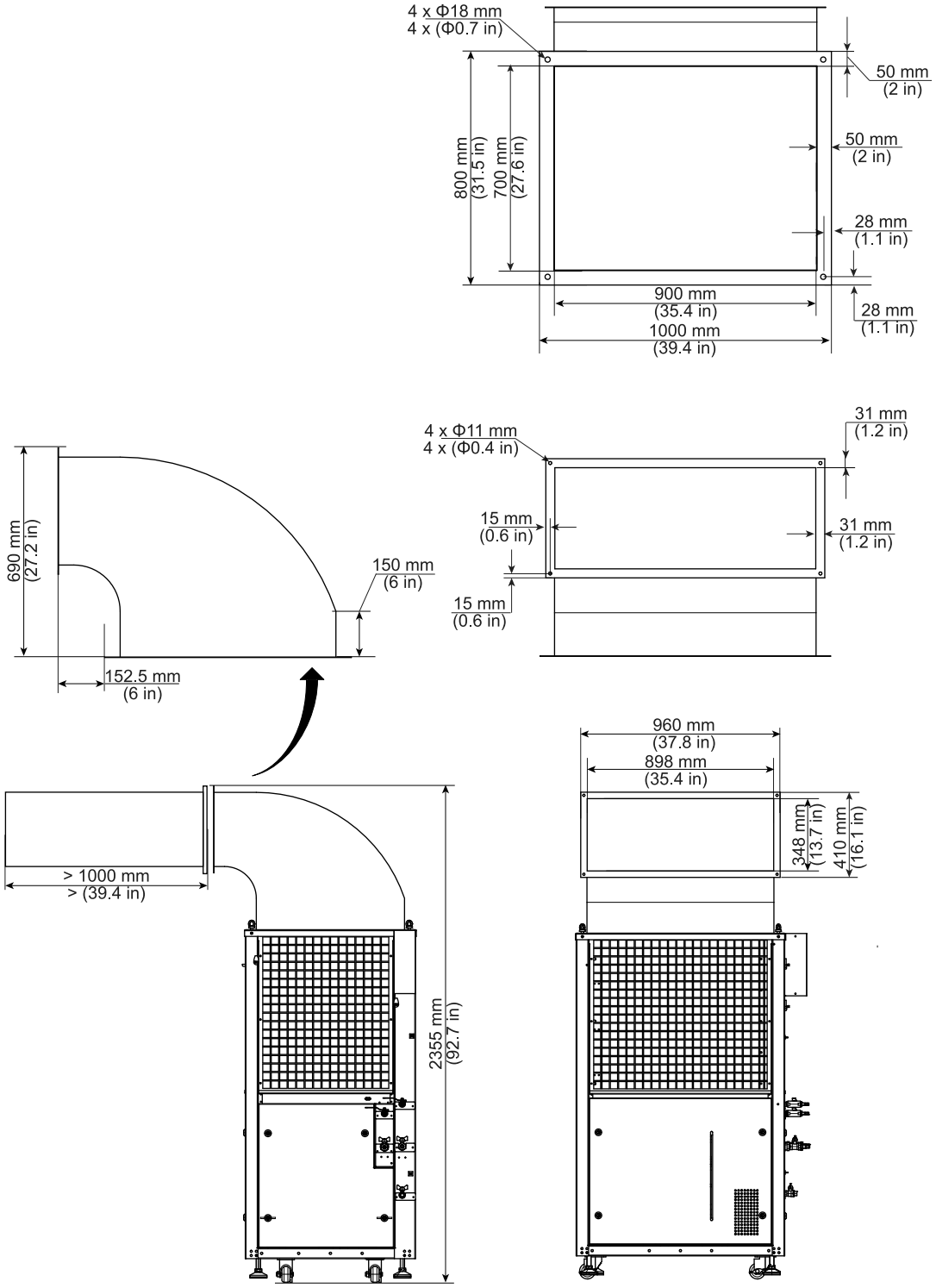
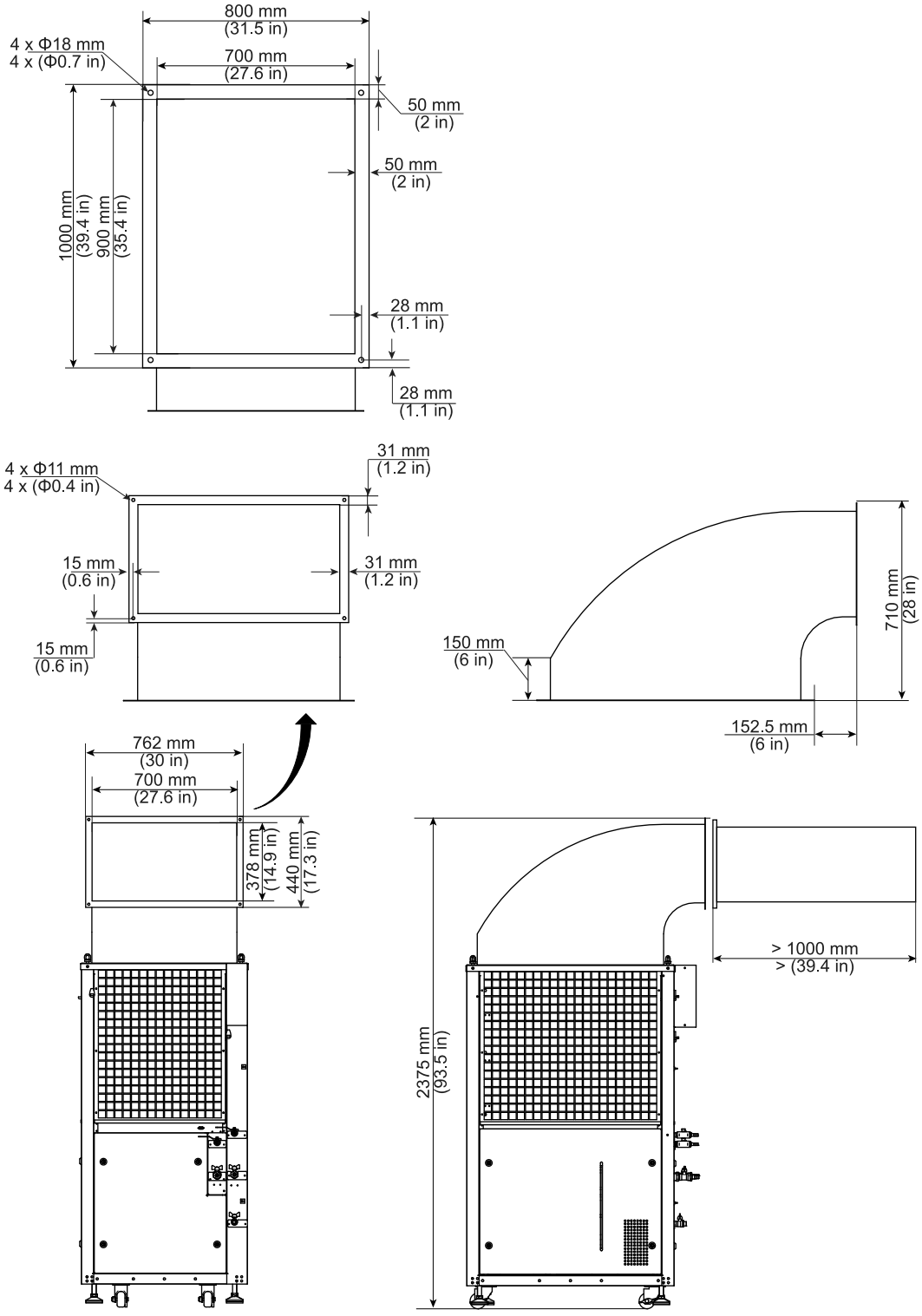


Figure 4-13 Duct (Option 2)



4.9 Magnet Monitor (MON) Requirements and Specifications

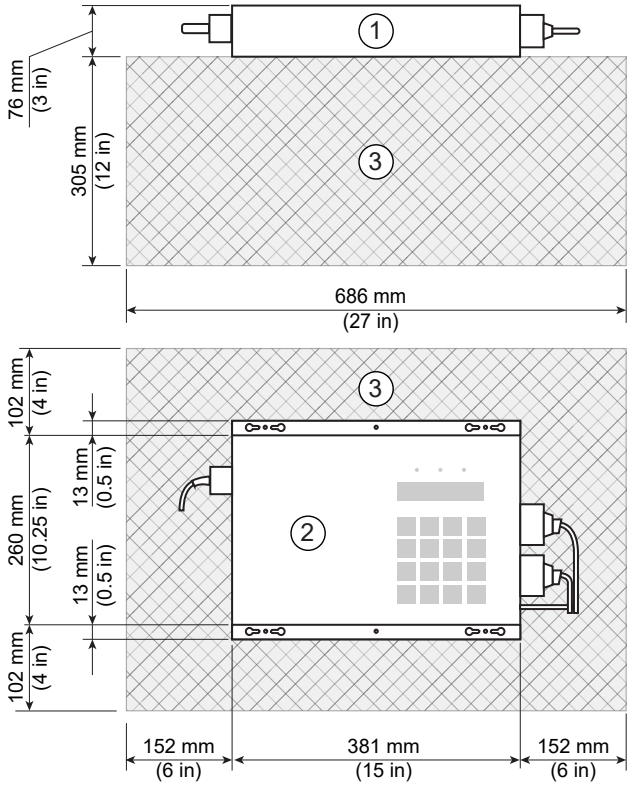
4.9.1 Requirements

1. Customer must supply T100 network connection with RJ45 connector to the Magnet Monitor (MON). Network connectivity must be active prior to magnet delivery.
2. The cable must be Cat 5 or better.
3. The network connection must not be routed through the Ethernet switch in the Global Operator Cabinet (GOC).

4.9.2 Specifications

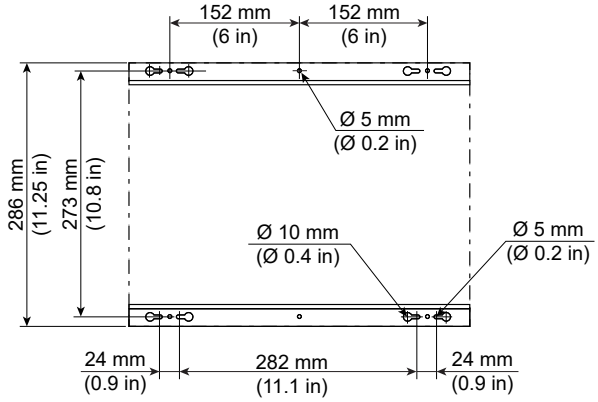
1. Mounting location: Wall installation in Equipment Room
2. Weight: 3.6 kg (8 lb.)
3. Magnetic Field Limit: 20 mT (200 gauss)
4. Power cord length: 1829 mm (72 in.)

Figure 4-14 Magnet Monitor (MON)



Item	Description	Item	Description
1	Top View	3	Service area
2	Front View	-	-

Figure 4-15 Magnet Monitor (MON) Mounting Patterns



4.10 Magnetic Resonance Elastography (MRE) Specifications (Optional Equipment)

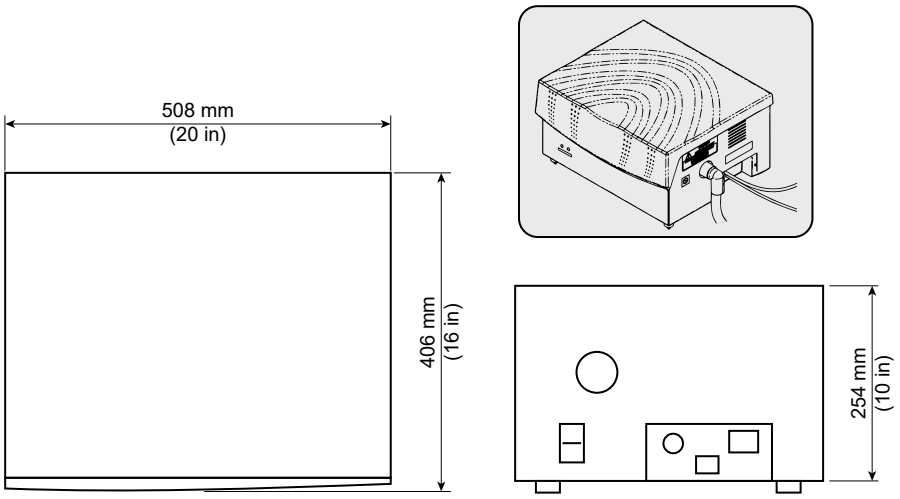
4.10.1 Requirements

1. The customer must work with the RF shield vendor to provide a waveguide for the 25 mm (1 in.) diameter tube.
2. MRE Resoundant Acoustic Driver location is limited to the length of the 25 mm (1 in.) tube (see the available cable lengths in 7.1.3 Magnetic Resonance Elastography (MRE) Option on page 118).

4.10.2 Specifications

1. Weight: 24.22 kg (53.4 lb.)
2. Magnetic Field Limit: 5 mT (50 G)
3. Power Cord Length:
   - 60 Hz: 6096 mm (240 in.)
   - 50 Hz: 7620 mm (300 in.)

Figure 4-16 Magnetic Resonance Elastography (MRE) Resoundant Acoustic Driver



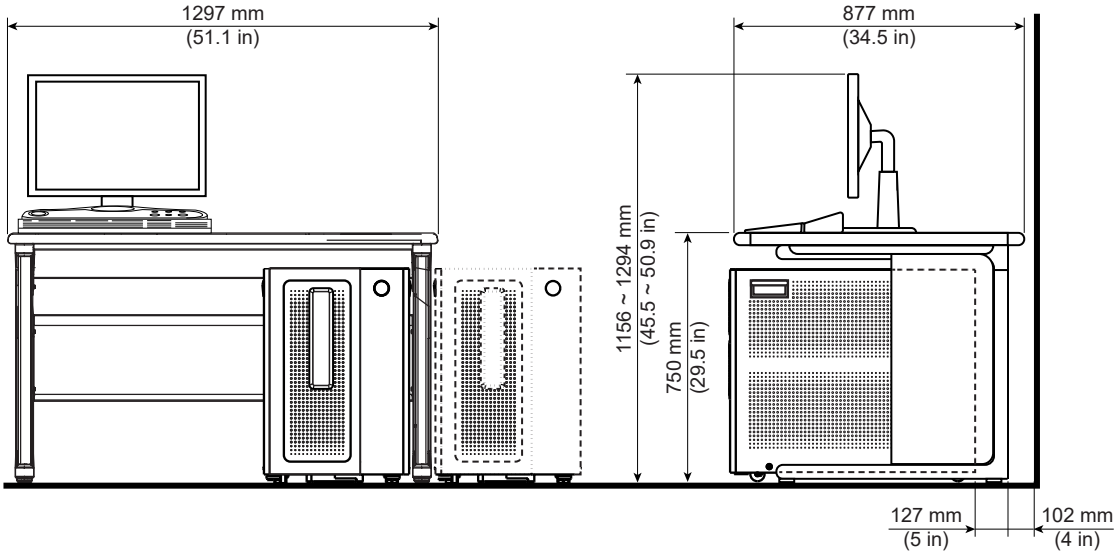
5 Control Room

5.1 Operator Workspace Equipment Specifications

(Applies to all sections within this chapter)

5.1.1 Operator Workspace Assembly

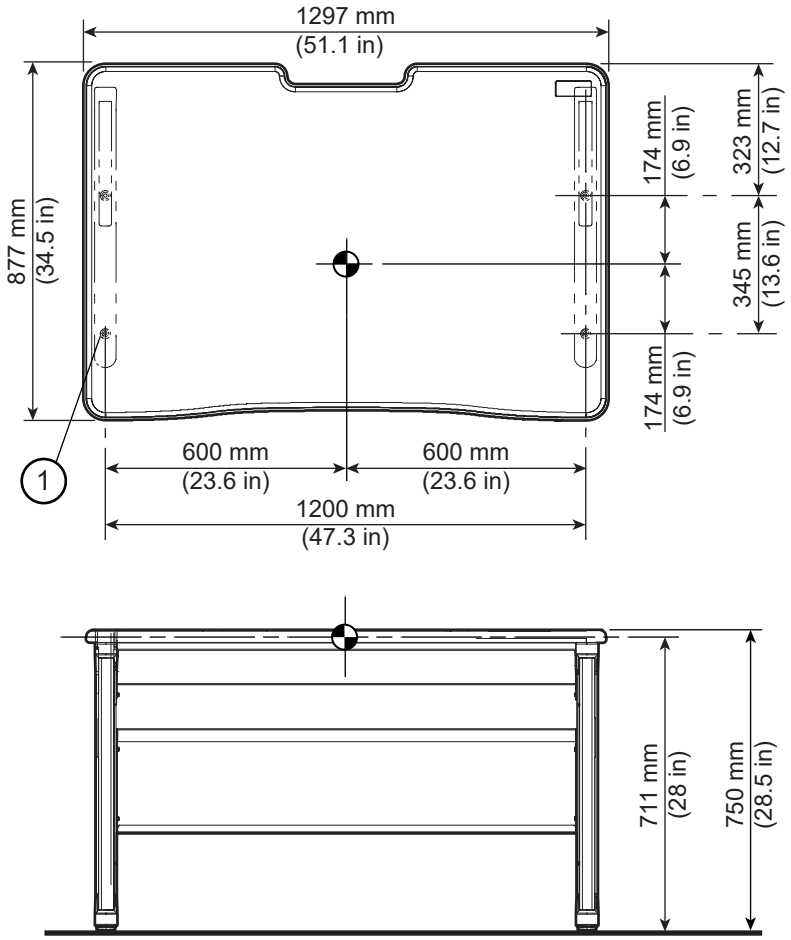
Figure 5-1 Operator Workspace Assembly



5.1.2 Operator Workspace (OW) (Optional Equipment)

1. Weight: 57 kg (125 lb.)
2. Magnetic Field Limit: 5 mT (50 G)

Figure 5-2 Operator Workspace (OW) Table (Top and Front View)



Item	Description
1	Four (4) 15.9 mm (5/8 in.) thru mounting holes for 9.5 mm (3/8 in.) seismic anchors

5.1.3 Global Operator Cabinet (GOC)

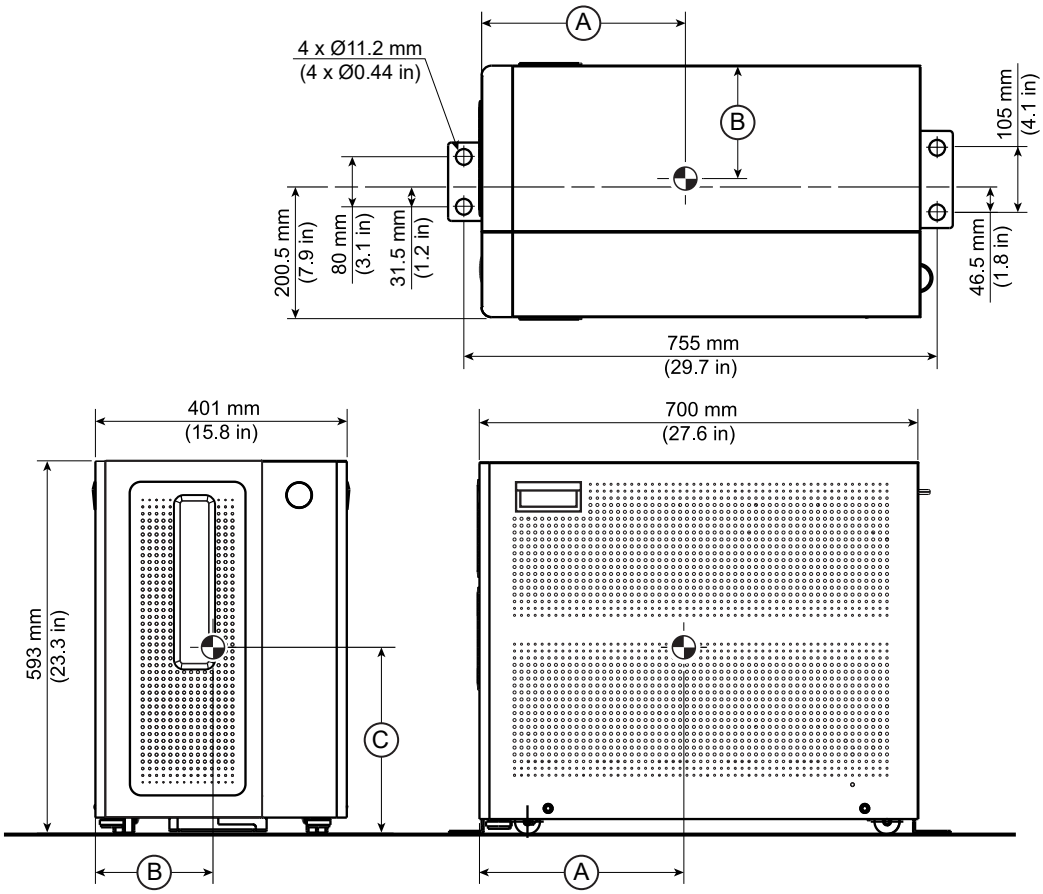
1. Weight:

   For Dell T5820: 57.6 kg (127 lb.)

   For HP Z4G5: 54.7 kg (120.6 lb.)

2. Magnetic Field Limit: 5 mT (50 G)
3. Anchor size: M10 (3/8 in.)

Figure 5-3 Global Operator Cabinet (GOC)



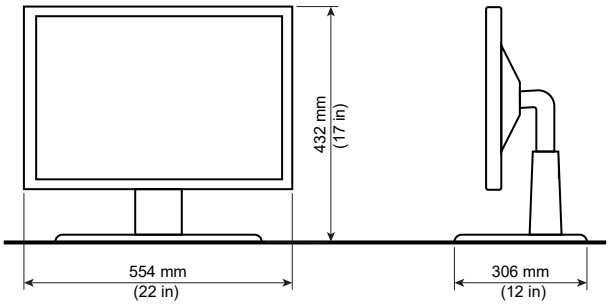
	A	B	C
Dell T5820	319 mm (12.9 in.)	194 mm (7.6 in.)	278 mm (10.9 in.)
HP Z4G5	375 mm (14.8 in.)	205 mm (8.1 in.)	330 mm (13 in.)

5.1.4 Host Display

Weight and dimensions for the Host Display are approximate and might vary depending on the display model.

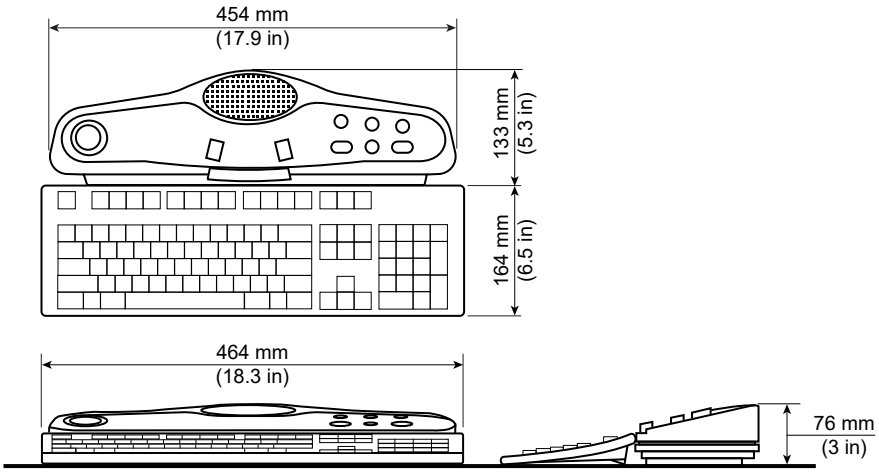
1. Weight: 6.7kg (14.8 lb.)
2. Magnetic Field Limit: 5 mT (50 G)

Figure 5-4 Host Display



5.1.5 Host Keyboard

Figure 5-5 Host Keyboard

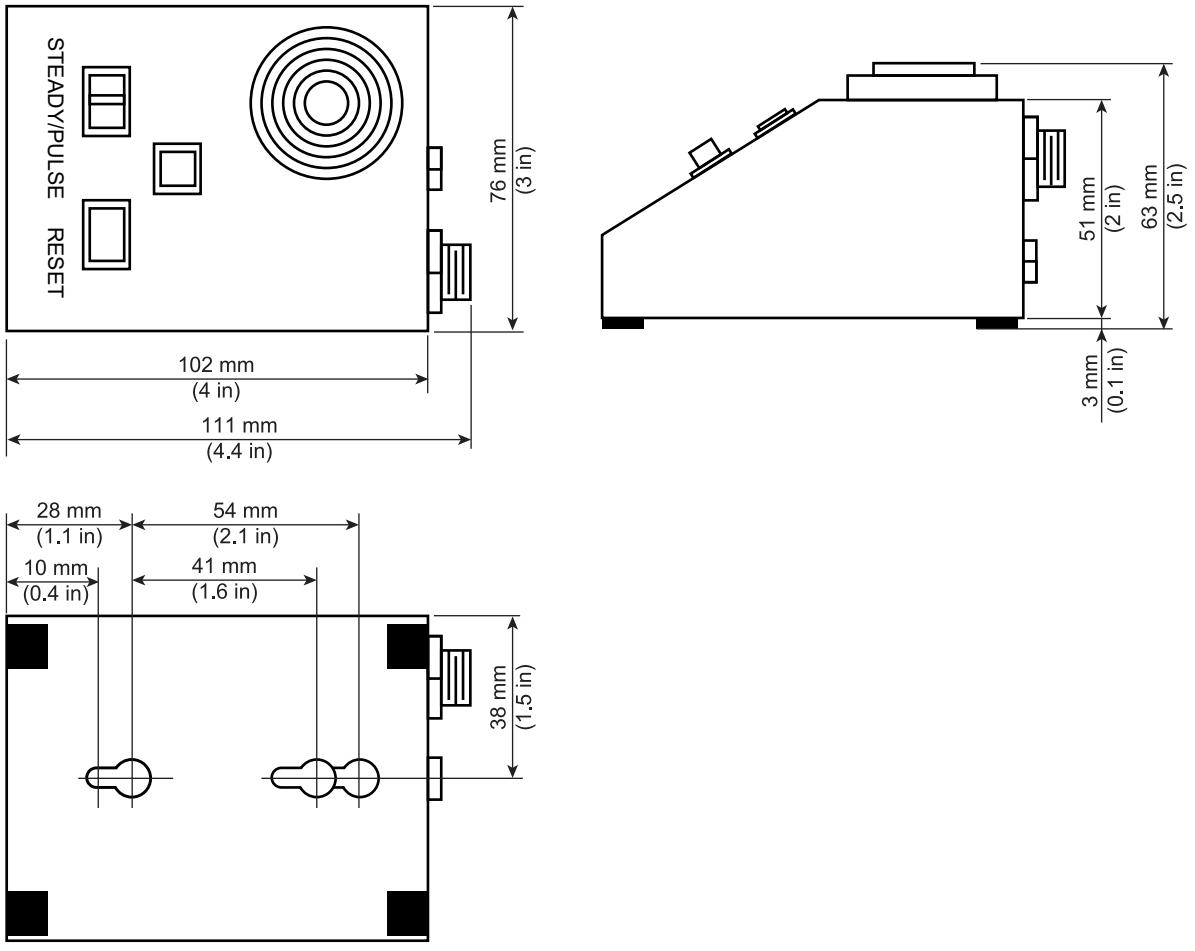


5.1.6 Pneumatic Patient Alert

The Pneumatic Patient Alert system allows the patient to contact the operator. The Control Box audible and visual alarm will be activated by the patient squeeze bulb which is located on the Magnet Enclosure and connected by pneumatic tubing through the Penetration Panel to the Control Box.

1. Weight 0.2 kg (0.5 lb.)
2. Magnetic Field Limit: 5 mT (50 G)
3. The Control Box must be placed or mounted within reach of the operator and within 1.5 m (5 ft.) of an electrical outlet.

Figure 5-6 Pneumatic Patient Alert (PA) with Mounting Pattern

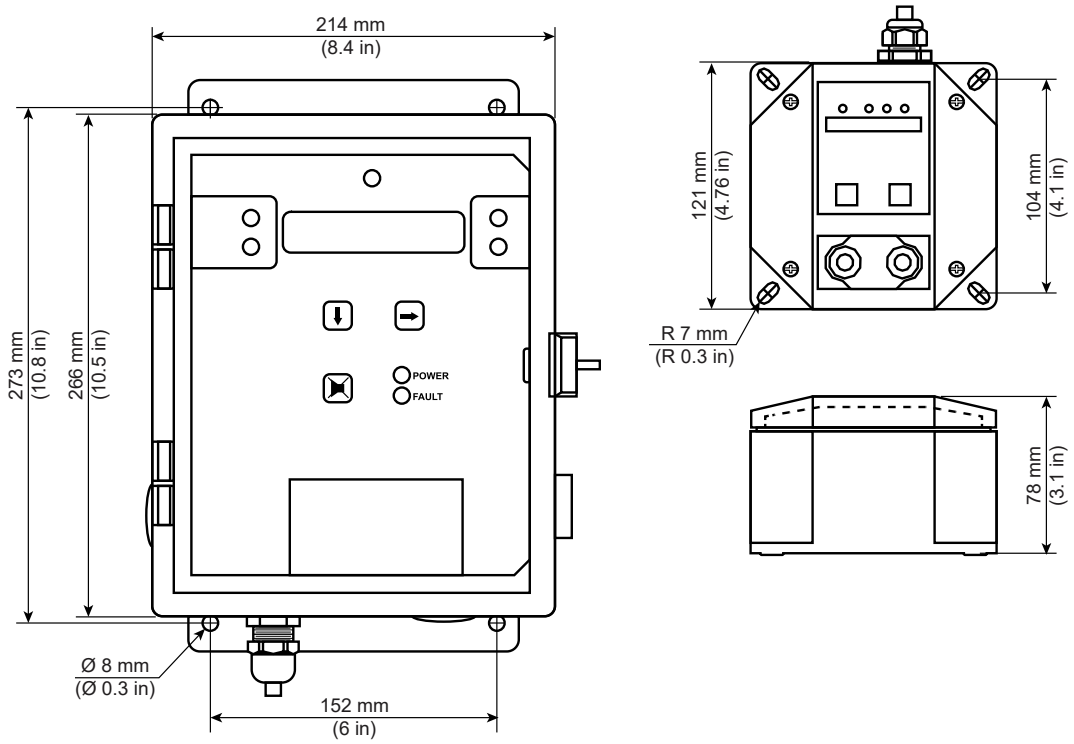


5.2 Oxygen Monitor (OXY) Specifications (Optional Equipment)

The optional Oxygen Monitor system consists of the Oxygen Monitor, the Remote Oxygen Sensor Module. The Oxygen Monitor alarm is located near the Operator Workspace is activated by the Remote Oxygen Sensor Module in the Magnet Room.

1. Oxygen Monitor Weight: 3.6 kg (8 lb.)
2. Oxygen Sensor Module Weight: 0.9 kg (2 lb.)
3. Magnetic Field Limit: 10 mT (100 G)

Figure 5-7 Oxygen Monitor and Remote Sensor



6 Digital Service and Connectivity Requirements

6.1 InSite RSvP (Remote Service Platform) Requirements

(Applies to all sections within this chapter)

6.1.1 InSite RSvP Connectivity Requirements

Following are the requirements for InSite RSvP connectivity:

1. The customer shall provide a physical connection or a route to an existing enterprise LAN.
2. The cable must be Cat 5 or better.
3. The customer shall provide outbound internet access for the device using HTTPS protocol over port 443.
4. The customer's network administrators shall provide DNS IP Address or Proxy IP address and authentication information (if applicable for the proxy server).
5. The customer's network administrators shall whitelist the following URLs:
   - Enterprise production:
     - `https://insite.gehealthcare.com:443`
     - `https://as1-insite.gehealthcare.com`
     - `https://as2-insite.gehealthcare.com`
   - Flexera URL: `https://gehealthcare-ns.flexnetoperations.com`
   - Flexera Software Download URL: `https://download.flexnetoperations.com`
   - For EU regions, whitelist the following:
     - `https://as1-insite-eu.gehealthcare.com`
     - `https://insite-eu.gehealthcare.com`

7 MR System Interconnects

7.1 MR System Interconnects Specifications

(Applies to all subsections within this section)

7.1.1 Component Designator Definitions

GE HealthCare uses Component Designators to identify system components. All subsystem cabinets and other components are referred to by their component designators in the Interconnect Data diagrams and tables.

Table 7-1 MR System Component Designators

Component Designator	Description
CRY	Cryocooler Compressor Cabinet
EO1/EO2	Emergency-Off (E-Off) Buttons
ICC	Integrated Cooling Cabinet
ISC	Integrated System Cabinet
LCS18	18kW Chiller
MAG	Magnet and Enclosure (all magnet enclosure components in the Magnet Room)
MDP	Main Disconnect Panel
MON	Magnet Monitor
MRU	Magnet Rundown Unit
OW	Operator Workstation
PA1	Pneumatic Patient Alert Control Box
PDU	Power Distribution Unit (PDU) is a module in the ISC
PED	Magnet Rear Pedestal
PP	Penetration Panel
PT	Patient Transport Table

Table 7-2 MR System Options Component Designators

Component Designator	Description
MRE	Magnetic Resonance Elastography
OXY	Oxygen Monitor
OM2	Remote Oxygen Sensor Module

7.1.2 Available Cable Lengths

To determine required cable lengths, find the total distance of the cable path between the specified equipment by measuring the following:

- distance from the bottom of the specified equipment to the cable trough
- horizontal distance of the cable trough
- distance from the cable trough to the bottom of the other specified equipment

Compare the total distance to the lengths specified in Table 7-3 Available Cable Lengths on page 115. If your distance is longer than the Usable cable length given in below list, you must reconfigure the layout of the room.

Table 7-3 Available Cable Lengths

Length Identifier (shown in the figure below)	Point A	Point B	Site Option: Short	Site Option: Long
			Usable cable length mm (in.) [1]	
Equipment Room				
L1	ICC, bottom (Type B) CRY, bottom (Type D)	PP, bottom	14000 (551)	
L3	MON	ICC, bottom (Type B) CRY, bottom (Type D)	10000 (394)	
L4	MON	PP, bottom	17400 (685)	
L5	MON	ISC, top panel	18200 (720)	
L8	PP, bottom	OXY	29600 (1165)	
L13	ISC, top panel	RF Door Switch	30500 (1200)	
L14	ISC, top panel	OW	29000 (1142)	
L15	OW	PP, bottom	28000 (1102)	
L16	ICC, top panel (Type B) LCS18, bottom (Type D)	ISC, top panel	9000 (354)	
L18	ICC, bottom (Type B) CRY, bottom (Type D)	ISC, top panel	9000 (354)	
L24	ICC, right side (Type B) LCS18, bottom (Type D)	ISC, left side	20000 (787) Flexible water tube routed in the equipment room.	
L25	LCS18, bottom (Type D)	CRY, bottom	8500 (335)	
L26[2]	MDP	Top of ICC (CRY power) (Type B)	7500 (295)	
		CRY power (Type D)	9000 (354)	

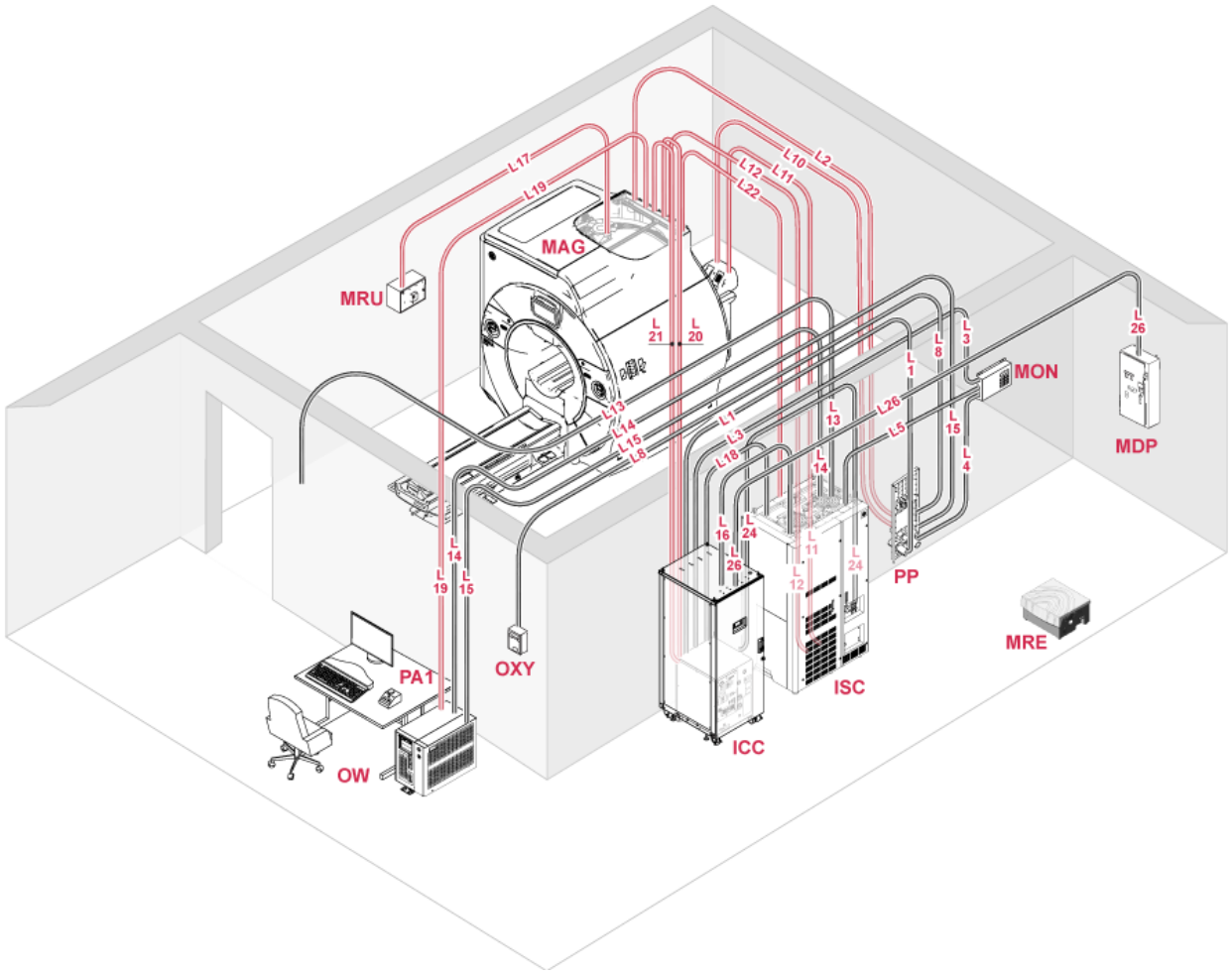
Table 7-3 Available Cable Lengths (Table continued)

Length Identifier (shown in the figure below)	Point A	Point B	Site Option: Short	Site Option: Long
			Usable cable length mm (in.) [1]	
Not shown	PP, bottom	E-Off switch, Control Room or Equipment Room	16800 (661)	
Not shown	PA1	Patient Alert Grip	Pneumatic tubing, 35000 (1378), is routed from patient alert control box to patient alert grip (through PAC and PAC Remote) through alert air line in PP1.	
Not shown	MON	Hospital ethernet switch	30000 (1181.1)	
Not shown	MON	Facility outlet for MON power	1827 (72)	
Magnet Room				
L2	PP, bottom	MAG, bottom back	12000 (472)	
Not shown	PP, bottom	E-Off switch, Magnet Room	16800 (661)	
Not shown	PP, bottom	OM2	25400 (1000)	
L10	PP, bottom	PED, bottom	14000 (551)	
L11	ISC, bottom	PED, bottom	13000 (512)	
L12 [3] (Gradient Cable)	ISC, bottom	MAG, bottom back	5000 (197)	14000 (551)
L17	MAG, top	MRU	30500 (1200)	
L19	OW	MAG, bottom back	43500 (1713)	
L20	CRY, bottom	MAG, bottom back	12000 (472) Flexible Helium Gas line routed through waveguides in PP1	
L21	ICC, bottom (Type B)	MAG, bottom back	17000 (669) Flexible water tubing routed through waveguides in PP1	
	LCS18, bottom (Type D)			
L22 (This length is for system cables)	ISC, bottom	MAG, bottom back	9500 (374)	

NOTE

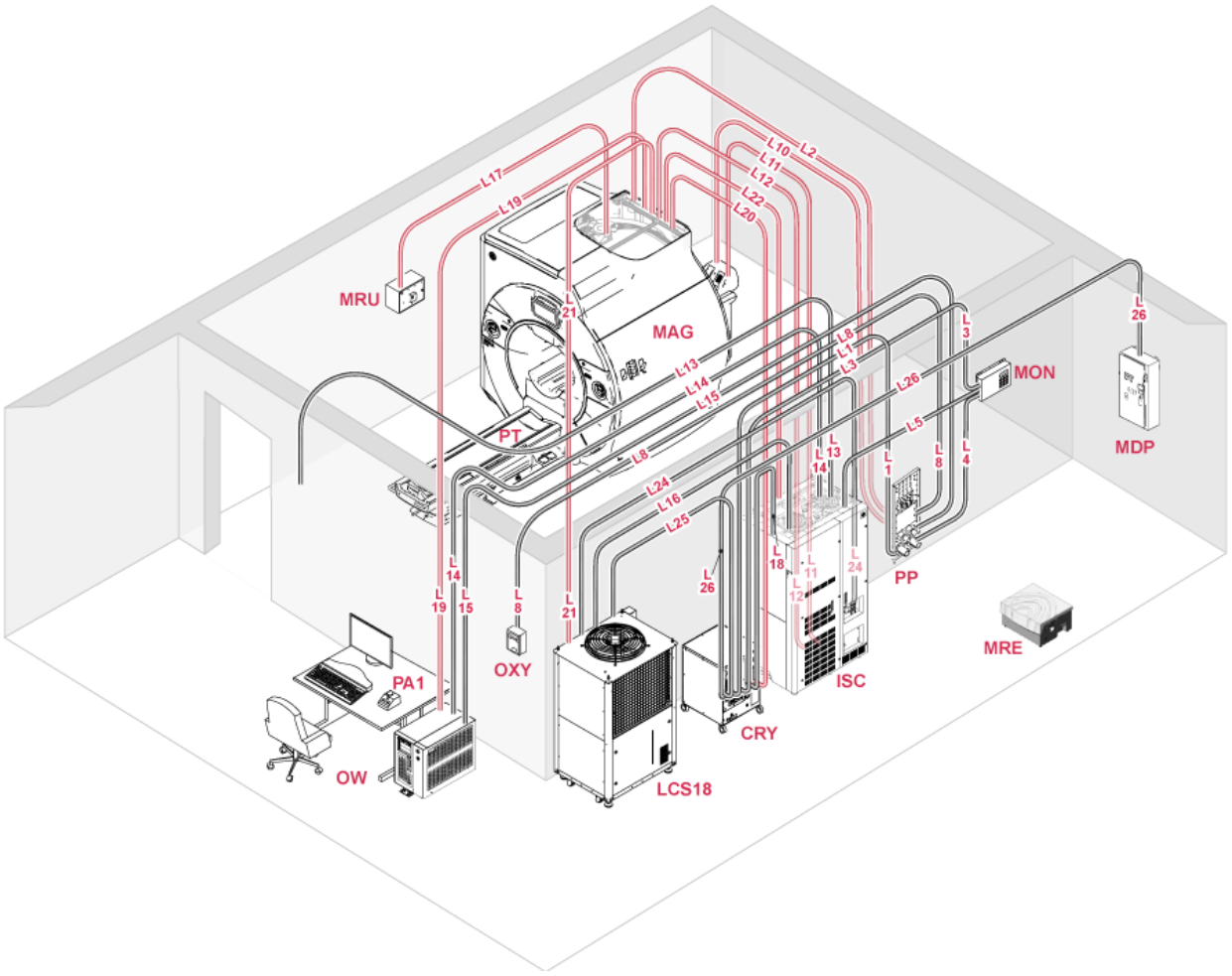
1. Usable length: Cable length minus take up at each end.
2. A customer-supplied substitute can be used if the supplied run is shorter than required.
3. Gradient cable has long and short configuration, the critical length depends on L22 for layout.

Figure 7-1 Available Cable/Hose Lengths for Type B



NOTE
MRE and OXY shown above are optional components of the system.

Figure 7-2 Available Cable/Hose Lengths for Type D



NOTE
MRE and OXY shown above are optional components of the system.

7.1.3 Magnetic Resonance Elastography (MRE) Option

Table 7-4 MRE Option Available Cable Lengths

Cable	Point A	Point B	mm (in.)
25 mm (1 in.) Tubing	Resoundant Active Driver	Magnet (Isocenter)	Nominal 7315 (288) Maximum 10058 (396)
BNC	Resoundant Active Driver	ISC	15240 (600)
Ethernet	Resoundant Active Driver	Ethernet Hub in ISC	15240 (600)
Power	Resoundant Active Driver	Customer-Supplied Outlet	60 Hz: 6096 (240) 50 Hz: 7620 (300)

7.2 MR System Interconnects Routing Requirements

(Applies to all subsections within this section)

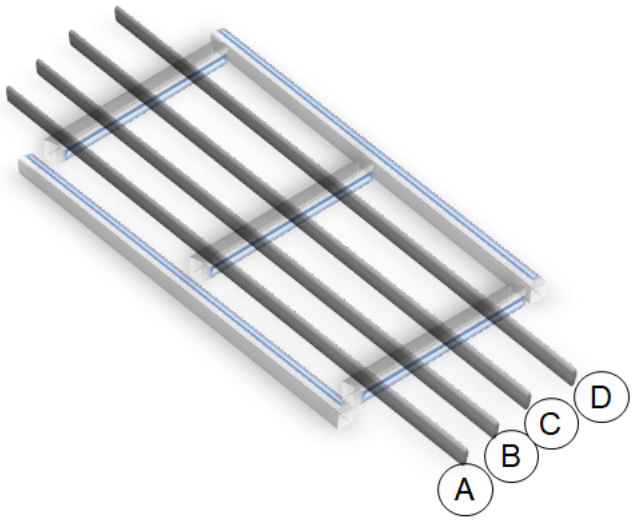
7.2.1 Cabling Requirements

1. The customer is responsible for the purchase and installation of all cable support mechanisms.

   NOTE
   The cable support in the Magnet Room is a pit or duct. A recommended duct example in the Magnet Room is shown in Figure 3-9 Duct or Pit Top View on page 73.

2. Any Magnet Room duct must attach to the RF Shield Room and the installation and routing of the duct or pit must be coordinated with the RF shield vendor.
3. Any type of nonferrous duct, such as composites or aluminum, may be used provided it meets all MR System requirements and any local and national codes.
4. All cables must enter the back of the magnet along the Z-axis (the Z-axis runs parallel to the patient table and the bore of the magnet).
5. The magnet-end subsection of the duct routing the gradient cables must be aligned to the center of the magnet (when viewed from the top).
6. Cables must be accessible for maintenance at all points along the route.
7. The duct or pit must accommodate a minimum cable bend radius of 300 mm (11.8 in.).
8. Gradient cables, signal cables, power cables, and hoses will be physically separated from one another along the route to minimize electrical noise coupling.

Figure 7-3 Cable Groups



Item	Description	Item	Description
A	Gradient Cables	C	Power Cables
B	Signal Cables	D	Hoses

9. All electrical and mechanical connections and fasteners must be tightened and secured to supplier specifications to prevent broadband interference
10. Excess cable length in the equipment must be stored in the Equipment Room.
11. Excess cable length in the Magnet Room must be stored in the pit or duct.

7.3 Facility-Supplied System Interconnects Specifications

On installation sites in China, make sure that the power cables and ground cables provided by customers have China Compulsory Certification (CCC). This information is supplied to the customer in China Power Cable Requirements, 5159493. (Go to the Customer Documentation Portal or contact the PMI.)

The following table lists the required facility-supplied system interconnects. Refer to Figure 7-4 Facility-Supplied System Interconnects on page 123 for additional information.

Table 7-5 Customer-Supplied Interconnections

Group	Between Units		Comments	Requirements
	From	To		
C01	Facility Power	MDP	Facility Power and Ground	MR Suite Electrical Requirements on page 48
C02	MDP	CRY	CRY Power	
C03	MDP	ISC	PDU Power	
	Facility Cooling Water	ICC	Type B Cooling Water Supply	MR System Facility Water Requirements on page 42
	Facility Cooling Water	ICC	Type B Cooling Water Return	
C04	Facility Network	MON	Facility must provide separate network access for the Magnet Monitor (MON), the Global Operator Cabinet (GOC) and the MDP. The MON connection must be available at all times.	4.9 Magnet Monitor (MON) Requirements and Specifications on page 104
	Facility Network	GOC		InSite RSvP (Remote Service Platform) Requirements on page 113
	Facility Network	Receptacle near MDP		4.2 Main Disconnect Panel (MDP) Requirements and Specifications on page 92
C05	MDP	E-Off Switch	Facility must supply cable from the MDP to the E-Off Switch in the Equipment Room.	MR Suite Electrical Requirements on page 48

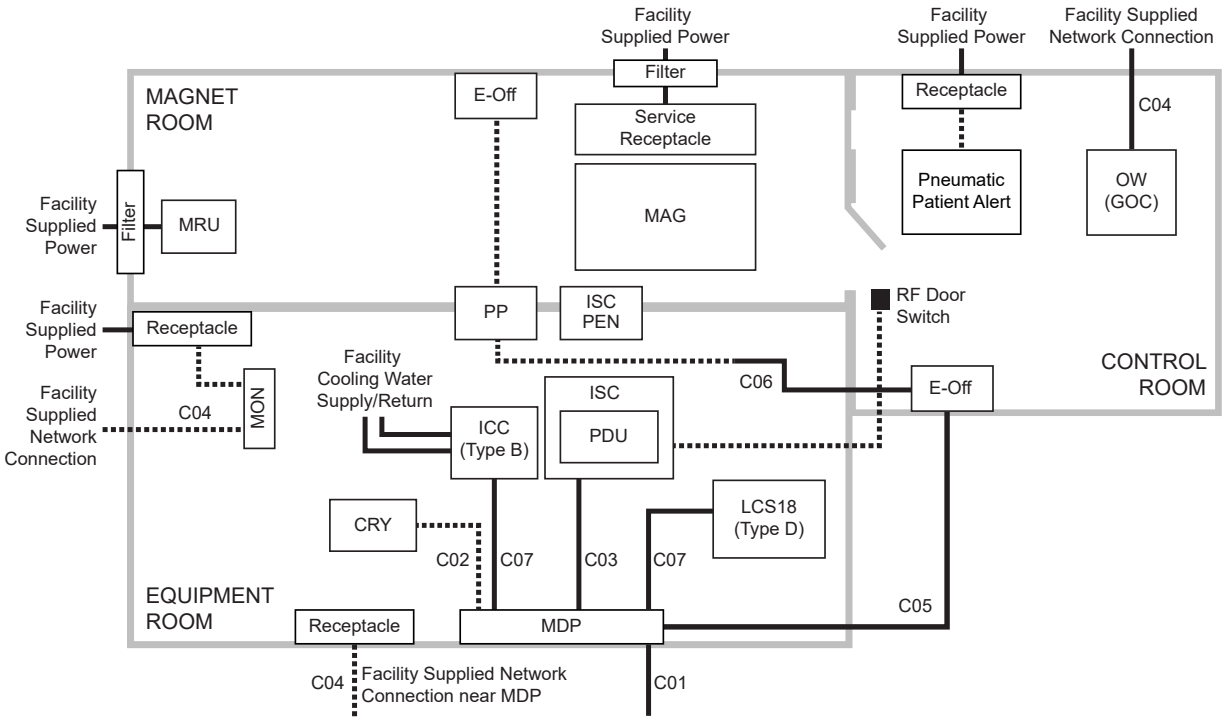
Table 7-5 Customer-Supplied Interconnections (Table continued)

Group	Between Units		Comments	Requirements
	From	To		
C06	PP	E-Off Switch in Control Room or Magnet Room	Facility must supply additional wiring between the GE HealthCare supplied cable and the E-Off switch if the length needed is greater than the available length listed in MR System Interconnects Specifications on page 114	MR Suite Electrical Requirements on page 48
C07	MDP	LCS18	Type D configuration LCS18 Power	MR Suite Electrical Requirements on page 48
	MDP	ICC	Type B configuration ICC Power	
	Facility Power	Outlet near MON	Facility outlet for MON power	MR Suite Electrical Requirements on page 48
	Facility Power	MRU	Facility power to MRU	Magnet Room Equipment Specifications on page 84
	Facility Power	Service Receptacle	Receptacle to be installed in Magnet Room, using appropriate filter.	MR Suite Electrical Requirements on page 48
	Facility Power	Pneumatic Patient Alert	Facility Power to Pneumatic Patient Alert	MR Suite Electrical Requirements on page 48

Table 7-6 Optional Facility-Supplied System Interconnects

Group	Between Units		Comments	Requirements
C01	Facility Power	Outlet near MRE	Facility outlet for MRE power (optional, not shown)	2.10 MR Suite Electrical Requirements on page 48
C01	Facility Power	Control room	Hardwired connection for OXY power (optional, not shown)	2.10 MR Suite Electrical Requirements on page 48

Figure 7-4 Facility-Supplied System Interconnects



Legend			
———	Facility supplied interconnect	·····	GE HealthCare supplied interconnect

NOTE
For Type B configuration, CRY is located within the ICC.

NOTE

- GE HealthCare recommends installing the RF Door switch on the outside wall of the Magnet Room.
- The illustration is not to scale and component positioning/interconnect runs are typical.
- Only GE HealthCare equipment interconnects are shown. Additional facility interconnects are required for non-GE HealthCare equipment (for example, Magnet Room DC Lighting).
- The E-Off button placement and cable routing shown indicates one possible configuration. Final E-Off button placement and cable routing is the responsibility of the customer. Refer to 2.10.1 General Electrical Requirements on page 48 for requirements for E-Off button placement.

The RF Shielded Room Vendor is responsible for installing the RF door switches. Refer to *RF Shielded Room Requirements*, 5850260-1EN.

8 Appendix

8.1 Glossary

Cryogen

A substance for producing low temperatures. Liquid helium is the cryogen used to cool the magnet to approximately 4 K (-269°C or -452°F).

Dewar

A container with an evacuated space between two highly reflective walls used to keep low temperature substances at near-constant temperatures. Liquid helium is usually stored and shipped in dewars.

Ferrous Material

Any substance containing iron which is strongly attracted by a magnetic field.

Gauss (G)

A unit of magnetic flux density. The earth's magnetic field strength is approximately one half Gauss to one Gauss depending on location. The internationally accepted unit is the tesla (1 tesla = 10000 G and 1 millitesla = 10 G).

Homogeneity

Uniformity. The homogeneity of the static magnetic field is an important quality of the magnet.

Isocenter

Center of the imaging volume ideally located at the magnet center.

Isogauss Line

A line on a field plot connecting identical magnetic field strength points.

Magnetic Field

A condition in a region of space established by the presence of a magnet and characterized by the presence of a detectable magnetic force at every point in the region. A magnetic field exists in the space around a magnet (or current carrying conductor) and can produce a magnetizing force on a body within it.

Magnetic Resonance (MR)

The absorption or emission of electromagnetic energy by nuclei in a static magnetic field, after excitation by a suitable radio frequency field.

Magnetic Shielding

Using material (for example, steel) to redistribute a magnetic field, usually to reduce fringe fields.

Quench

Condition when a superconducting magnet becomes resistive thus rapidly boiling off liquid helium. The magnetic field reduces rapidly after a quench.

Radio Frequency (RF)

Frequency intermediate between audio frequency and infrared frequencies. Used in magnetic resonance systems to excite nuclei.

Radio Frequency Shielding

Using material (for example, copper, aluminum, or steel) to reduce interference from external radio frequencies. A radio frequency shielded room usually encloses the entire Magnet Room.

Resonance

A large amplitude vibration caused by a relative small periodic stimulus of the same or nearly the same period as the natural vibration period of the system. In magnetic resonance imaging, the radio frequency pulses are the periodic stimuli which are at the same vibration period as the hydrogen nuclei being imaged.

Superconducting Magnet

A magnet whose magnetic field originates from current flowing through a superconductor. Such a magnet is enclosed in a cryostat.

Superconductor

A substance whose electrical resistance essentially disappears at temperatures near zero Kelvin. A commonly used superconductor in magnetic resonance imaging system magnets is niobium-titanium embedded in a copper matrix.

Tesla

The internationally accepted unit of magnetic flux density. One tesla is equal to 10000 Gauss. One millitesla is equal to 10 Gauss.

Waveguide

A hollow linear structure used in components such as the penetration wall to route cables and hoses, while limiting and controlling electromagnetic waves from entering the Magnet Room.

8.2 MR Site Vibration Test Guidelines

(Applies to all subsections within this section)

8.2.1 Test Measurements

1. Vibration measurements must be in the range of 10^{-6} g. Test equipment must have the required sensitivity to these levels.
2. Instrumentation must have a low tolerance to temperature effects since many times the low frequency thermal drift may influence the measurements.
3. All measured data must be acquired real time. Recording of vibration data will not allow for a correct site survey, specifically when studying transient vibration and when searching for specific vibration sources.
4. All analyses must be narrow-band Fast Fourier Transforms (FFT) over the frequency bands listed in Table 8-1 Frequency Bands for FFT on page 126.
5. Time histories of the vibration must be recorded as acceleration levels vs. time. The resolution of the time history must be adjusted to clearly capture the transient event. The analyzer set-up will be site dependent and, in special cases, vibration response dependent. It is the responsibility of the vibration consultant to study the transient environment, capture data to confirm that transient activity exceeds the trigger level, then expand the time history data to exhibit the structural response.

Table 8-1 Frequency Bands for FFT

Frequency Band	Frequency Resolution
0.2 to 50 Hz	Δf= 0.125 Hz

8.2.2 Equipment (Spectral Analyzer) Set-Up

1. Frequency average should be a minimum of 20 linear averages (Do not use peak hold or 1/3 octave analysis).
2. Average and store should be a minimum of 20 plots steady state and 20 plots transient to support the consistency of the site vibrations.
3. Hanning windows must be applied to the entire spectra.
4. Spectrum analyzers capable of these measurements are readily available for purchase or rental. Models, such as the HP 3560A, Nicolet Phaszer, B&K Pulse, and HP 35670, are all capable of making the site vibration measurements. Accelerometers must have the capability to measure from 0.2 Hz beyond 50 Hz. Time histories can be recorded using any of the analyzers listed above.

NOTE
The equipment mentioned is for example only. It is the responsibility of the Engineering Test Firm to provide equipment that will allow measurements compliant with this guideline.

8.2.3 Data Collection

8.2.3.1 Ambient Baseline Condition

1. All of the measurements listed above must be made in a “quiet” environment—that is, areas where excessive traffic, subway trains, and so on, do not exist. A vibration measurement must also be made during periods without traffic or during periods of light traffic. Measurements must define the lowest levels of vibration possible at the site.
2. The source of any steady state vibration, whose level exceeds the magnet specifications found in Magnet Room Structural Requirements on page 64, must be identified. A second measurement should be made with all of the identified contributors powered down if possible. In situations where it is not possible to power down equipment, vibration data must be collected to identify the specific source of the vibration concern. The majority of steady state vibration problems can be negated by isolating the vibration source.

8.2.3.2 Normal Condition

1. All of the vibration measurements listed above must be repeated during periods of “normal” environmental conditions, including the Fast Fourier Transforms (FFTs) and time histories. The transient measurements must be provided to define the dynamic disturbances the MR System may be exposed to. Transient analysis is required for a true assessment of the site.
2. Special attention must be paid to the site assessment during the entire analysis. Since transient vibration is not easily addressed once the MR suite is fully constructed, the test consultant must fully understand the needs for this analysis. The source of any transient vibration must be identified and supported with vibration plots. If the source of any transient vibration is not locatable, it is recommended that the customer have an alternate location identified and the vibration studied.
3. Transient vibration can be difficult to assess if the details are not understood. The **0.0005 g, zero-to-peak trigger level** is a starting point to understanding the vibration stability. The transient vibration peak amplitude, structural (time variant) response, decay rate and an estimate of the number of events per unit of time would constitute a complete transient analysis. All transient failures must be supported by time history plots. The plots must clearly show the structural response, the frequency of the signature and the decay rate. From this data, GE HealthCare can help determine compliance with the vibration guidelines.
4. The test consultant must provide site data to show the design recommendations for all sites/building structures meet the magnet specifications found in Magnet Room Structural Requirements on page 64.

8.2.4 Presentation/Interpretation of Results

1. The recommended format for site vibration data collection, presentation, and analysis is demonstrated in the examples in 8.2.4 Presentation/Interpretation of Results on page 127, Figure 8-1 Acceleration Time History on page 128, and Figure 8-2 Acceleration Time History (Zoomed In on Transient Event) on page 129. Presentation of the data in any other format (linear units only) may result in incorrect interpretation and diagnosis of the site. Additional data collection or presentation methods are at the option of the vibration testing service.
2. All plots must be properly annotated with:

    2.1. Instrumentation setup including number of averages, frequency resolution, and so on

2.2. Test location

2.3. Test conditions:

2.3.1. Steady state

2.3.2. Transient

2.3.3. Heel drop

2.3.4. Normal environment

2.3.5. Typical traffic

2.3.6. Any other conditions necessary to demonstrate understanding of potential sources of vibration

3. The customer's vibration testing service is responsible for interpreting the results and determining if that site meets GE HealthCare specifications.
4. If the vibration levels are too high, additional data acquisition may be necessary to:

4.1. Determine the source of the vibration

4.2. Propose a solution to the problem

4.3. Find an alternate site location

5. Any questions regarding test equipment requirements, test parameters, or general questions should be discussed with the GE HealthCare Project Manager of Installation (PMI).

Figure 8-1 Acceleration Time History

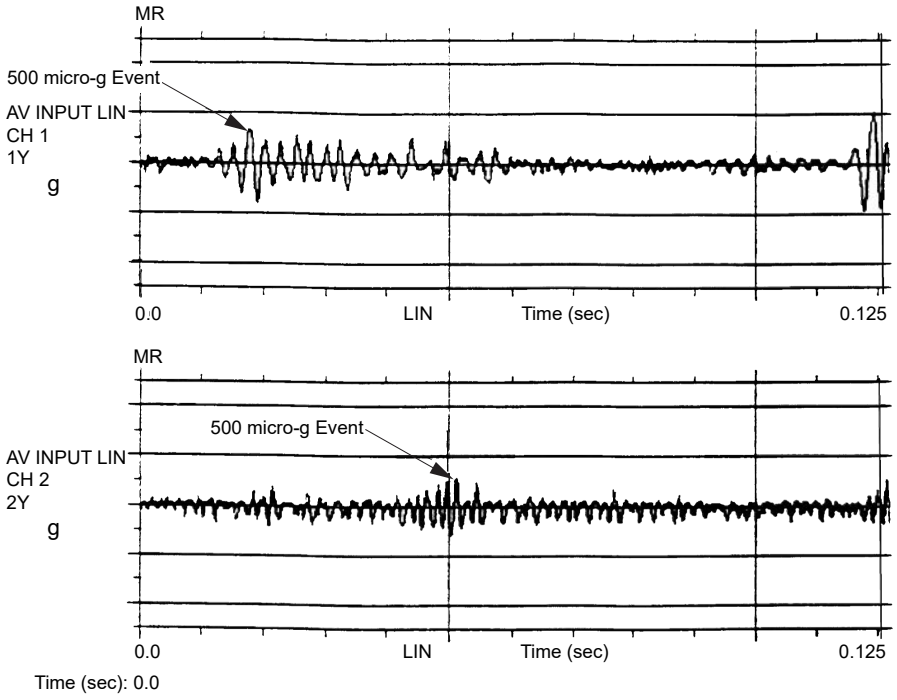
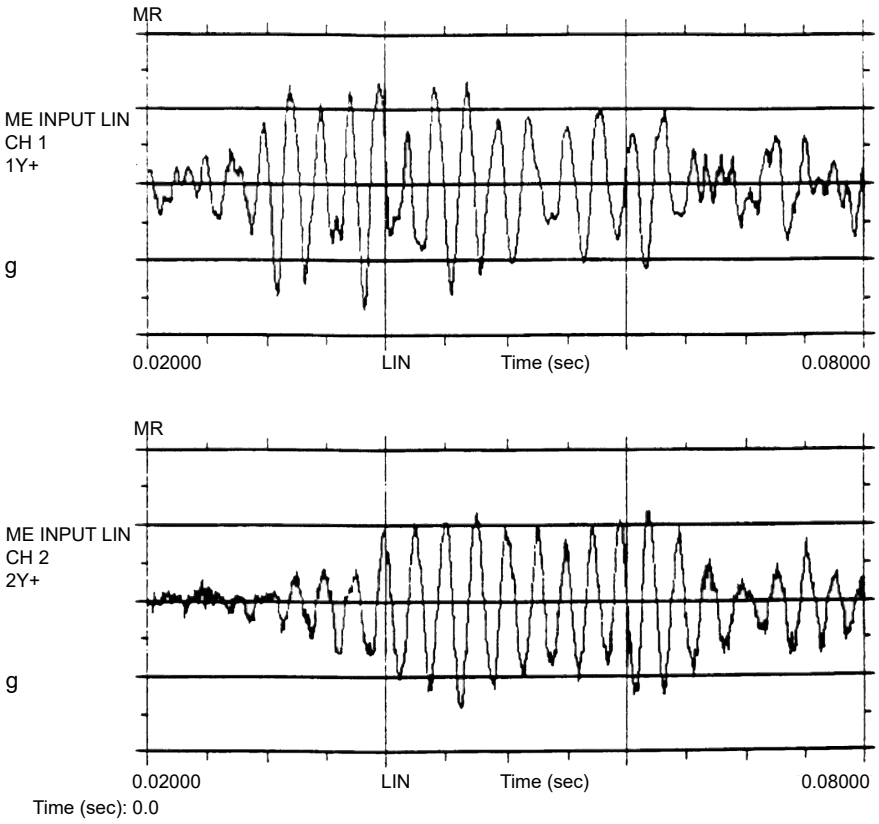


Figure 8-2 Acceleration Time History (Zoomed In on Transient Event)



8.3 Sample Calculation AC Power Equipment Minimum Distance

This is a sample calculation to determine minimum distance from a feeder, transformer, or other AC electrical source, using the formula found in 2.6.3 Electrical Current on page 36 to determine minimum distance from a feeder, transformer, or other AC electrical source.

I (amps) = $20x^2$ (meters) ÷ S (meters)

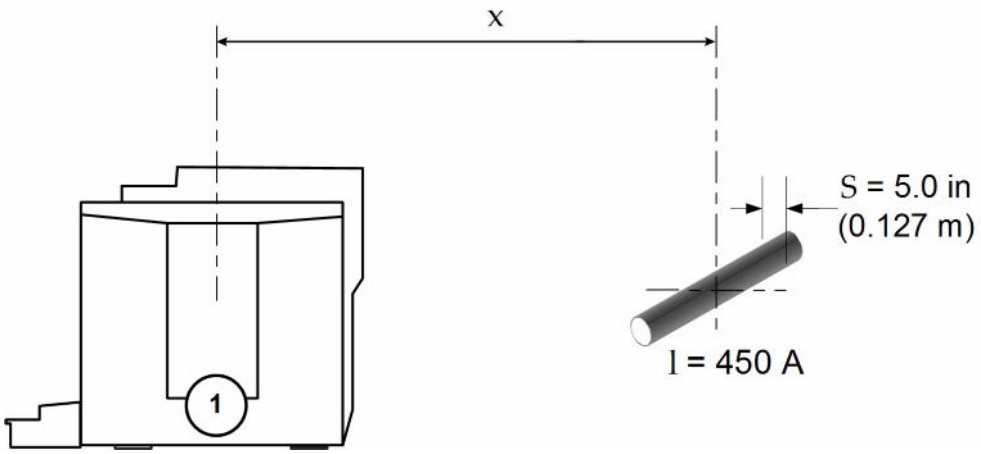
Note that the formula has three variables. If you have two of them, you can calculate the third. In this example, we calculate the minimum distance **x** from the source—in this case, a main electrical feeder carrying 450 amps of current in a 127 mm (5 in.) conduit.

Rearranging:	$x^2 = \frac{I \times S}{20}$ $x = \sqrt{\frac{I \times S}{20}}$

where:	
x	Minimum distance (in meters) from the feeder lines to isocenter of the magnet
I	Maximum allowable RMS single phase current (in amps) or maximum allowable RMS line current (in amps) in three phase feeder lines
S	Separation (in meters) between single phase conductors or greatest separation between three phase conductors

The separation **S** is the spacing between the conductors, and when all 3 conductors are run in a single conduit, **S** is simply the diameter of the conduit.

S = 5 inches = 0.127 meters



Item	Description
1	Magnet

$$x=\sqrt{\frac{450\,\mathrm{A}\times 0.127\,\mathrm{m}}{20}}$$ The conduit should be 1.7 m (5.6 ft.) from the magnet isocenter.

In other situations, the spacing **S** may be the spacing between HV feeders, the distance between transformer lugs, or the spacing between conduits when the phase conductors are run in separate conduits.

What if it is too close?

If this is an existing condition, you should request an *EMI study* to quantify the magnitude and direction of the AC disturbances. The calculation is worst-case and does not take into account the vector direction of the AC interference. The magnet is only sensitive to AC disturbances that are directed horizontally (magnet z-axis). Also, the calculation does not account for any magnetic shielding effect of steel conduit.

8.4 Selecting Anchor Size

The following is an example to illustrate the selection of correct anchors to install a magnet in a building with 13.8 MPa (2000 psi) concrete. For this example the area is not under seismic requirements.

1. Determine the magnet clamping force (for the Magnet: 11100 N + 900 N = 12000 N (2500 lb. + 200 lb. = 2700 lb.)).
2. Refer to the examples of anchor vendor catalogs below to select the anchor diameter and embedment that meets the clamping force (tension) determined in Step 1.

   Diameter : ≥ 15.875 mm (0.625 in.) ≤ 31.75 mm (1.25 in.)

   For 203 mm (8 in.) embedment select 19 mm (0.75 in.) diameter

   For 114.3 mm (4.5 in.) embedment select 25.4 mm (1 in.) diameter

   or

   Diameter : Min. M16 Max. M32

   For 130 mm embedment select M20 diameter

   For 114 mm embedment select M24 diameter
3. The vendor instructions and torque to the maximum recommended level for the anchor selected in Step 2 must be provided to the RF shielded room vendor for correct installation of the anchor and equipment.

Table 8-2 Allowable Anchor Loads in Concrete (English Units)

Anchor Diameter mm (in.)	Embed-ment Depth mm (in.)	13.8 MPa (2000 psi)		20.7 MPa (3000 psi)		27.6 MPa (4000 psi)		41.4 MPa (6000 psi)	
		Tension kN (lb.)	Shear kN (lb.)	Tension kN (lb.)	Shear kN (lb.)	Tension kN (lb.)	Shear kN (lb.)	Tension kN (lb.)	Shear kN (lb.)
15.9 (5/8)	70 (2 3/4)	**5.6 (1250)**	**12.5 (2800)**	**7.1 (1600)**	**13.7 (3070)**	**8.1 (1810)**	**14.8 (3300)**	**8.5 (1920)**	**12.5 (3330)**
	102 (4)	**8.3 (1870)**	**14.8 (3330)**	**10.7 (2400)**	**14.8 (3330)**	13.0 (2930)	14.8 (3330)	14.2 (3200)	12.5 (3330)
	178 (7)	**11.2 (2500)**	**14.8 (3330)**	13.4 (3010)	14.8 (3330)	16.2 (3650)	14.8 (3330)	16.2 (3650)	12.5 (3330)
19.1 (3/4)	83 (3 1/4)	**6.9 (1550)**	**12.8 (2880)**	**8.7 (1950)**	**14.7 (3310)**	**10.5 (2350)**	**16.6 (3730)**	**11.6 (2610)**	**21.4 (4800)**
	121 (4 3/4)	**11.2 (2510)**	**20.1 (4510)**	14.5 (3250)	20.7 (4650)	17.2 (3870)	21.4 (4800)	20.8 (4670)	21.4 (4800)
	203 (8)	13.0 (2930)	21.4 (4800)	17.2 (3870)	21.4 (4800)	20.2 (4530)	21.4 (4800)	22.8 (5120)	21.4 (4800)

Table 8-2 Allowable Anchor Loads in Concrete (English Units) (Table continued)

Anchor Diameter mm (in.)	Embedment Depth mm (in.)	13.8 MPa (2000 psi)		20.7 MPa (3000 psi)		27.6 MPa (4000 psi)		41.4 MPa (6000 psi)	
		Tension kN (lb.)	Shear kN (lb.)	Tension kN (lb.)	Shear kN (lb.)	Tension kN (lb.)	Shear kN (lb.)	Tension kN (lb.)	Shear kN (lb.)
25.4 (1)	114 (4 1/2)	13.9 (3120)	27.0 (6080)	17.2 (3870)	30.1 (6770)	20.5 (4610)	33.2 (7470)	21.4 (4800)	33.2 (7470)
	152 (6)	19.6 (4400)	33.2 (7470)	28.5 (6400)	33.2 (7470)	32.0 (7200)	33.2 (7470)	32.6 (7330)	33.2 (7470)
	229 (9)	24.9 (5600)	33.2 (7470)	35.59 (8000)	33.2 (7470)	41.77 (9390)	33.2 (7470)	41.8 (9390)	33.2 (7470)

NOTE
All bolded values in this table fail to meet the clamping force (tension), and are therefore not acceptable anchors.

Table 8-3 Allowable Anchor Loads in Concrete (Metric Units)

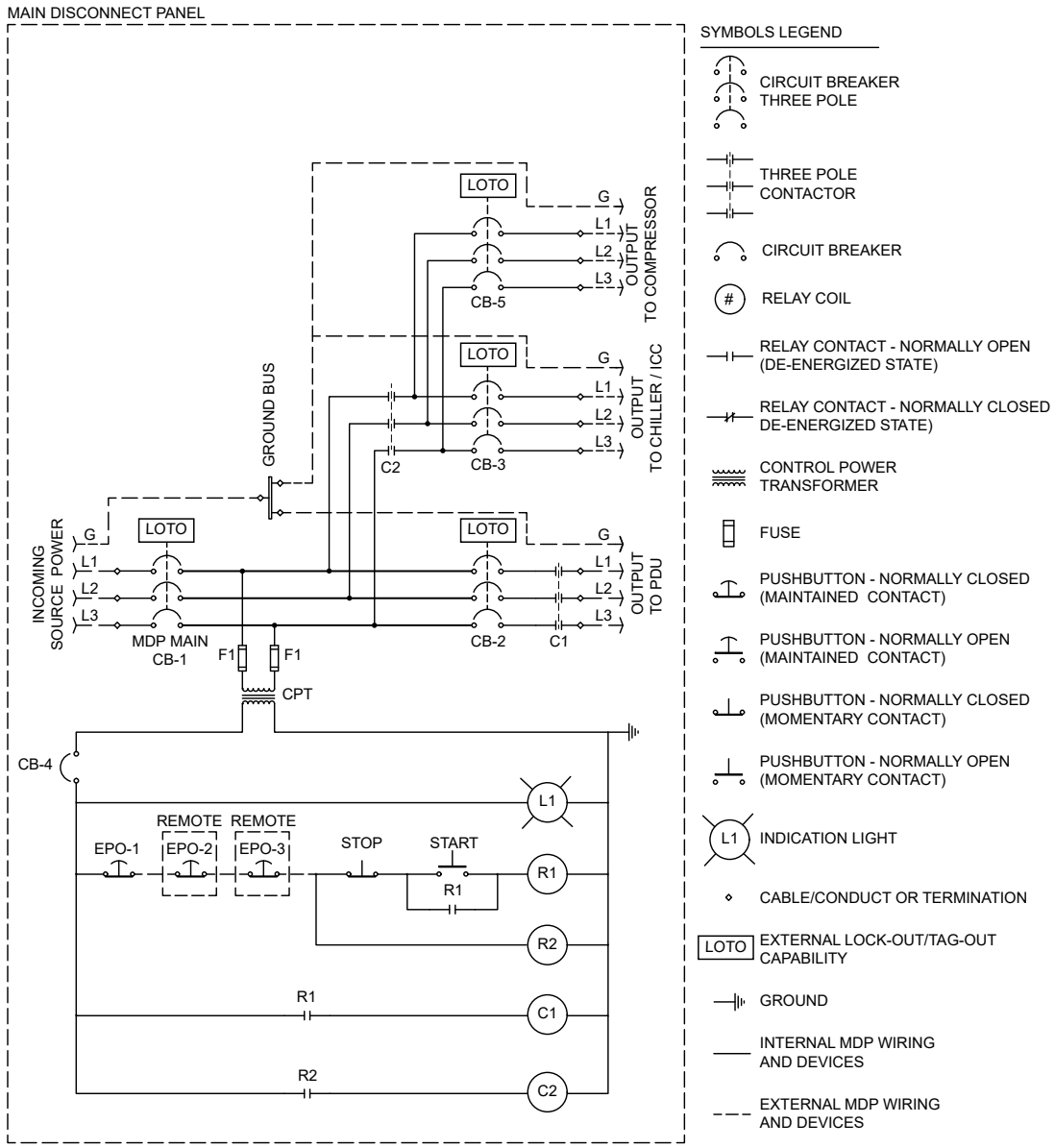
Anchor Diameter	Embedment Depth mm (in.)	13.8 MPa (2000 psi)		20.7 MPa (3000 psi)		27.6 MPa (4000 psi)		41.4 MPa (6000 psi)	
		Tension kN (lb.)	Shear kN (lb.)	Tension kN (lb.)	Shear kN (lb.)	Tension kN (lb.)	Shear kN (lb.)	Tension kN (lb.)	Shear kN (lb.)
M16	105 (4 1/8)	**11.2 (2500)**	**25.1 (5650)**	20.9 (4705)	39.9 (8965)	24.2 (5450)	45.0 (10125)	30.7 (6900)	46.9 (10550)
M20	130 (5 1/8)	25.1 (5650)	52.9 (11900)	30.7 (6910)	58.7 (13195)	36.4 (8175)	64.5 (14490)	44.5 (10005)	64.5 (14490)
M24	155 (6 1/8)	30.0 (6735)	61.2 (13760)	36.9 (8300)	70.5 (15855)	43.9 (9860)	29.8 (17950)	57.7 (12980)	95.6 (21490)

NOTE
All bolded values in this table fail to meet the clamping force (tension), and are therefore not acceptable anchors.

8.5 Sample control schematic for customer-supplied MDP

This section provides an example of a control schematic for the auto-restart and Emergency Power Off (EPO) functions that meets the minimum GE HealthCare PIM requirements. This schematic does not include control, protection, wiring or devices that may be required due to local safety and regulatory requirements. Only the minimum equipment, devices and wiring is shown to meet the performance requirements of GE HealthCare equipment. The final MDP design must be compliant with applicable local codes and regulations.

Figure 8-3 Customer MDP control schematic



Revision History

Revision	Date	Description
Controlled document for English is posted as DOC2733560.		
1	September 2022	Initial release.
2	October 2022	Add R series magnet information for the Vibration see **Figure 2-6 Vibration Transmitted through VibroAcoustic Mat for R series magnet**. Add R series magnet information on section **2.6.1 Magnetic Fringe Field**. Update **Table 2-18 MR System Components Shipping Specifications** for adding LCC magnet information Add **Figure 3-2 Magnet Steady State Vibration Specificationsfor R series magnet**. Add LCC magnet weight in **3.6.1 Magnet (MAG) Assembly Specifications**.
3	March 2024	Chapter 2.2.2 Add item 8 Optional: Magnetic Resonance Elastography (MRE) Chapter 2.2.5 Add MRE to the Figure 2-1 System Overview for Type B, Figure 2-2 System Overview for Type D Chapter 2.2.5 Add MRE to Note Chapter 2.3 Add item 5 GE HealthCare optional equipment, such as MRE, accessories, and so on. Chapter 2.8.2 Add MRE info to Table 2-7 System Options Heat Output for Air Cooling Chapter 2.10.1 Add Optional MRE Resoundant Acoustic Driver requirement to Table 2-10 Facility Power Requirements Chapter 2.10.1 Correct the type error for Table 2-11 System Power Demand Chapter 4.2.2 Remove M50022MA wording and figure Chapter 4.10 Add section 4.10 Magnetic Resonance Elastography (MRE) Specifications (Optional Equipment) Chapter 7.1.1 Add MRE to Table 7-2 MR System Options Component Designators Chapter 7.1.2 Add MRE to Note, Figure 7-1 Available Cable/Hose Lengths for Type B, Figure 7-2 Available Cable/Hose Lengths for Type D Chapter 7.1.3 Add section 7.1.3 Magnetic Resonance Elastography (MRE) Option Chapter 7.3 Add MRE info to Table 7-6 Optional Facility-Supplied System Interconnects

Revision	Date	Description
Controlled document for English is posted as DOC2733560.		
4	October 2024	• Table 2-2: Updated the values. • Figure 2-20: Updated make it more clear • Figure 2-21: Updated make it more clear • Table 2-11: Updated the values • Table 2-13: Updated the values • Table 2-16: Updated to add F50L for 200, 208VAC • Table 2-18: Updated weight for ISC • Table 2-19: Updated weight for ISC • Section 3.5.3 Removed the Figure 3-12 and Figure 3-15 • Section 3.5.6 Added R series magnet info, updated step 6 and added step 7 for seismic info. • Figure 3-4, Figure 3-5, Figure 3-7, Figure 3-8, Figure 3-19, Figure 3-20: Updated make it more clear • Figure 3-21: Updated the patient table view and dimensions • Section 4.3: Updated weight • Figure 4-4: Updated CoG dimensions • Figure 4-8: Added callout 6 • Section 5.1.3 Added weight for HPZ4G5 • Figure 5-3: Added callouts and callout table • Figure 5-5:Updated dimensions • Table 7-3, Figure 7-1 and Figure 7-2: Added L26 for MDP power cable

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